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ABSTRACT

As one of four volumes in a K-12 series, this teaching guide contains classroom and outdoor activities pertaining to the environment and energy for seventh through ninth grades. The guide was developed based upon the understanding that environmental education can serve as an instructional umbrella covering many topics (conservation, marine education, city planning, population, etc.) and that it is not a specific subject but an interdisciplinary theme. The activities are organized around four major topics: natural environment, built environment, social institutions and decision making, and energy and environmental resource management. Each section begins with a summary of issues related to that topic followed by a listing of major concepts and their associated objectives. One activity is presented to teach each objective (approximately 40). Objectives correspond with those contained in the California "Course of Study" guide for 1981-84. Each activity provides a brief description, the objective, purpose, time, topics, location, materials, lead-up and preparation procedures, and follow-up activities. Appendices list the sources for the activities, California resource agencies, and teaching materials available from these agencies. In the beginning of the guide, a procedure is outlined for planning an environmental education program. (DC)

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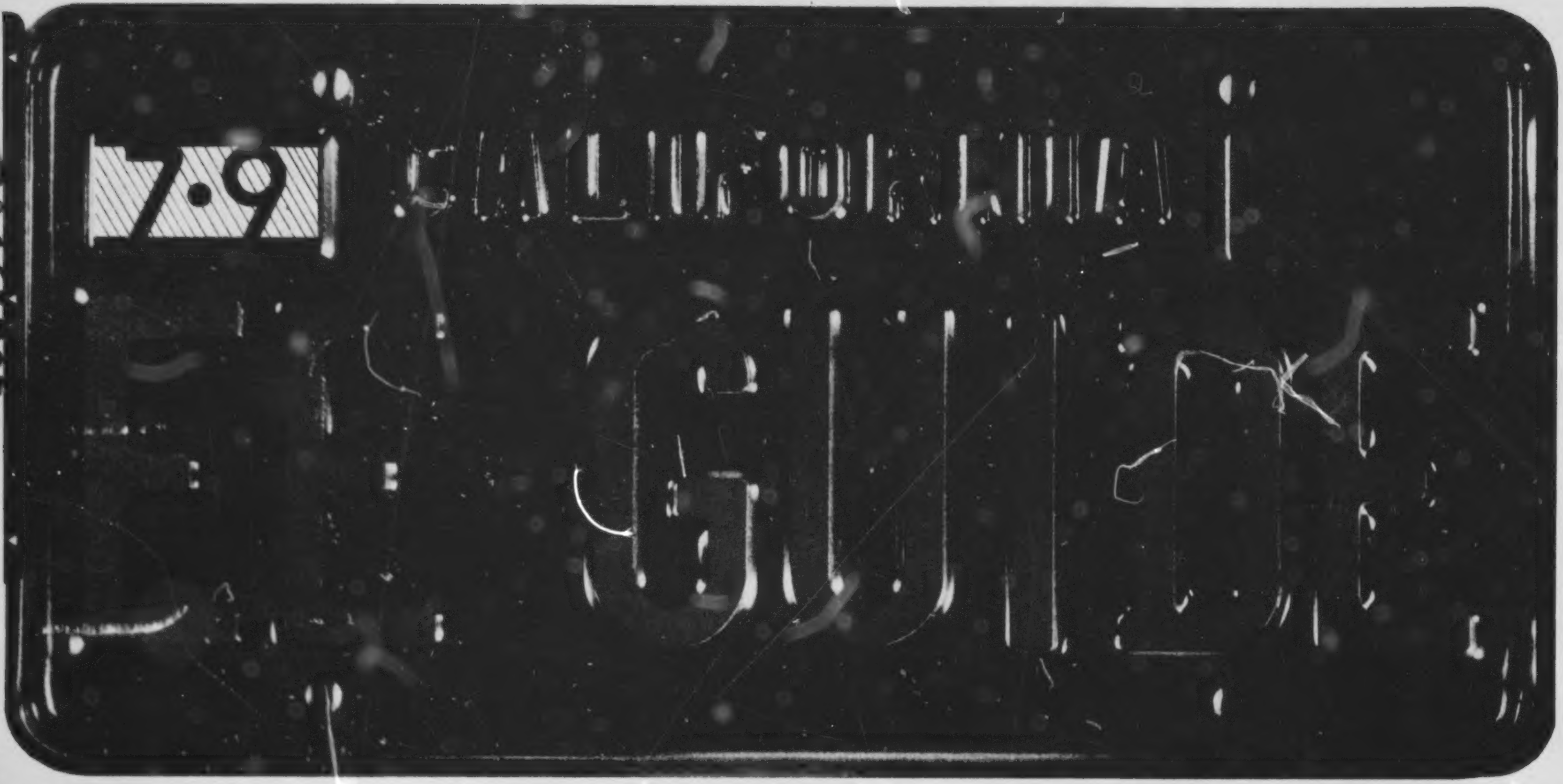

ENVIRONMENTAL EDUCATION GUIDE

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Environmental Education Guide
Volume 3

An Environmental/Energy Education Primer for Grades Seven through Nine
1981 - 1984

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In cooperation with the California State Department of Education
Wilson Riles, Superintendent of Public Instruction

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Joint Policy Statement
Environmental/Energy Education

California's abundant varied and productive natural resources coupled with a high degree of environmental quality have enabled our citizens to live highly rewarding and productive lives. Successful continuation of a high quality of life for us all depends upon how well we conserve, manage, and utilize energy and natural resources and safeguard our environment.

Wise resource and environmental management involves the intelligent cooperation of governmental resource management agencies, private industry, and concerned and informed citizens acting individually or through their elected and appointed officials.

Intelligent and effective citizen participation in resource and environmental conservation requires knowledge in a number of areas, including the sciences, social sciences, and humanities. It requires the development of skills which enable each person to live in a manner which supports environmental quality. It involves commitment to get involved and work for a better life for all Californians now and in the future.

Our schools play a key role in the development of what amounts to an informed public environment ethic.

Instruction must be provided at all grade levels and in all appropriate subject matter areas. Outdoor learning experiences should be provided and full use should be made of services, materials, and expertise offered by resource management agencies, citizen conservation associations, businesses, industries, and others. Teachers must understand the importance of their role in environmental education, possess the necessary knowledge and skills in this area of instruction, and be provided with adequate instructional materials and equipment.

The Department of Education and the Resources Agency share responsibility for encouraging the development and maintenance of an effective environmental/energy education program for the schools of California. In recognition of this responsibility, we, the Superintendent of Public Instruction and the Secretary for Resources, agree to provide appropriate services, materials, and expertise to the schools and to coordinate our efforts in a statewide program.

We further urge educators and resource management personnel at all levels to work together for the benefit of the most precious resource of all, the youth of California.

Wilson Riles
Wilson Riles
Superintendent of
Public Instruction

Huey D. Johnson
Huey D. Johnson
Secretary for Resources

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The project manager and staff would like to express their appreciation for the professional contributions of the many environmental educators throughout the state.

We owe an enormous debt to our colleagues whose assistance throughout the entire development of this curriculum guide made it possible to move to the next developmental phase. Each phase required a particular kind of expertise and the California environmental education community responded admirably. Rudy Schafer, Environmental/Energy Education Coordinator for the State Department of Education, provided the principal leadership for the development of this Guide. He worked very closely with us throughout the entire project, providing valuable environmental education curriculum materials from California, throughout the United States, and many foreign countries. His support and encouragement were most appreciated.

Esther Railton, Director of Environmental Education at California State University, Hayward, was the principal consultant for the development of the environmental education conceptual framework. Her background, reputation, and experience in environmental education were invaluable to the project team. Upon completion of the environmental education framework, a group of environmental educators from throughout the state were invited to a workshop at the Asilomar Conference Center for the review, critique, and modification of the suggested framework's goals (concepts) and objectives, which were developed under Dr. Railton's guidance. The following people participated at the Asilomar workshop:

Bill Baker
Alameda County Superintendent of Schools
Hayward

Dorothy Bjur
University of Southern California
Los Angeles

Edith Carlston
Pittsburg Unified School District
Pittsburg

Grant Cary
Laurel Ecology Center
Van Nuys

Cheryl Christiansen
Humboldt County Office of Education
Eureka

Jack Davidson, *Los Angeles County Superintendent of Schools*
Downey

Teresa DeBono
Alameda County Superintendent of Schools
Hayward

Bob Flasher
The Oakland Museum
Oakland

Ron Fontaine
Kern High School District
Bakersfield

John Harter
School of Education
University of California, Berkeley

Marlynn Kaake
Lincoln Middle School
Alameda

O. E. Leaf
Department of Conservation
Sacramento

Nat Pearson
Alameda County Superintendent of Schools
Hayward

Gloria Refuerzo
Highlands School
Pittsburg

Robert Ryan
California State Department of Education
Sacramento

Rudy Schafer
California State Department of Education
Sacramento

Barbara Steinberg
Marin County Office of Education
San Rafael

Bruce Stewart
Moss Landing Marine Laboratory
Moss Landing

Vince Vandre
Department of Fish and Game
Sacramento

Debra Voss
Solid Waste Management Board
Sacramento

Randy West
La Vista High School
Orangevale

Molly Whitely
Napa Junction School
Napa

The next major task of the project team was to form a research team to review curriculum programs, guides, and materials from throughout the country to determine what environmental education activities matched the concepts and objectives of the environmental education framework. The following individuals tenaciously pursued this task until activities were matched to each objective of the framework:

Kathryn Slichter
Friends of the Earth
San Francisco

Carolie Sly
Environmental Education Consultant
Berkeley

Alice Watt, Research Assistant
California State University
Hayward

Abby Zurier
Environmental Education Consultant
Palm Springs

Teachers and curriculum experts from all over the state were then selected to review the activities the research team had chosen to determine the best and most appropriate activities for each of the environmental education objectives. There were four such workshops and the following people were involved:

Jeanette Biasotti
Rancho Romero School
Danville

Jerry Bishop
Castro Valley High School
Castro Valley

Lee Boyes
Egling Middle School
Colusa

Maxine Burnworth
Parkside School
Pittsburg

Edith Carlston
Pittsburg Unified School District
Pittsburg

Evelyn Cormier
Brookvale School
Fremont

Sam Dederian
Galileo High School
San Francisco

Linda DeLucchi
Lawrence Hall of Science
Berkeley

Gail Faber
Rancho Romero School
Danville

Bert Felton
Rancho Romero School
Danville

Joe Fontaine
Kern High School
Bakersfield

Phil Gordon
Rancho Arroyo Junior High School
Hayward

Joe Hamilton
New Haven Unified School District
Union City

Gary Heath
Lawrence Hall of Science
Berkeley

Toris Jaeger
Orinda Unified School District
Orinda

Marlynn Kaake
Lincoln Middle School
Alameda

Marcia Batcheller-Kallison
Piedmont Middle School
Piedmont

Margaret Kelley
Coyote Hills Regional Park
Fremont

Sylvia Kendzior
Rancho Arroyo School
Danville

Kathy King
Logan High School
Union City

Dallas LaBlanc
Southwood Junior High School
San Francisco

Carol Libby
Loma Vista School
Vallejo

Rich Lohman
Albany High School
Albany

Helen McKenna
Washington High School
San Francisco

Larry Malone
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Unified School District
Sacramento

Nancy Olson
Pittsburg Unified School District
Pittsburg

Erma Owens
Garfield School
Oakland

Lynne Porteous, *Fort Funston*
San Francisco Unified School District
San Francisco

Esther Railton
California State University
Hayward

Gloria Refuerzo
Highlands School
Pittsburg

Karen Reynolds
Oakland Unified School District
Oakland

Melva Rush
Thornton Junior High School
Fremont

Helga Schwab
Earhart School
Alameda

Marilyn Shaver
Bel Air School
Pittsburg

Phyllis Shuck
Olive School
Novato

Sylvia Smith
Pittsburg Unified School District
Pittsburg

Barbara Steinberg
Marin County Office of Education
San Rafael

Ray Watson
Walters Junior High School
Fremont

Randy West
La Vista High School
Orangevale

Molly Whiteley
Napa Junction School
Napa

Bev Wu
Lakeview School
Oakland

When the teacher workshops were completed, we discovered that there was a need to revise and adapt many of the activities to match the objectives more closely. In some cases, the teachers felt that none of the activities they had reviewed was appropriate or acceptable; this required developing original classroom activities. The majority of the writing was done by Larry Rose, San Francisco environmental and energy education consultant, and Carolie Sly. In addition, Carolie had the delicate responsibility of coordinating the efforts of the writing team. The following people also contributed to the writing efforts and to them we owe a debt of gratitude:

Bob Flasher
The Oakland Museum
Oakland

Gary Heath
Lawrence Hall of Science
Berkeley

Marcia Batcheller-Kallison
Piedmont Middle School
Piedmont

Larry Malone
Lawrence Hall of Science
Berkeley

Steve Wilkes
Anna Kirchgater School
Sacramento

Molly Whiteley
Napa Junction School
Napa

Randy West reviewed the California State Resource Agencies materials, selected those that were appropriate for classroom use, and matched those materials to the major areas of concern.

Without Shelle Bolar, Maycelle Elliott, Bonnie Halligan, Marie Perez, and Dorothy Vallerga — secretaries in the Instructional Support Services Unit — who spent endless hours typing this Guide, it never could have become a reality.

The drawings in this Guide are those of Louis LaBrie, Oakland artist. And finally, thanks to John O'Lague and his Publications Services staff, Douglas Arthur, Salvador Cortez, Linda Henderson, and Cindy Price, for editing, designing, and typesetting the Guide.

This Guide has truly been a cooperative effort by the environmental education community; we wish to express our appreciation to all.

August F. Scornaienchi

HISTORICAL DEVELOPMENT OF THE GUIDE

The modern environmental movement which began in the late 1960's has brought about major changes in the ways in which Americans relate to the land, its resources, and to each other. In the early 1970's, the term environmental education came into use as a means of describing an appropriate educational response to this new ethic.

In 1973, the California State Department of Education published a book entitled **Ekistics — A Guide for the Development of an Interdisciplinary Environmental Education Curriculum.** The publication was based on the work of Paul Brandwein, and specified learning experiences in three broad areas in which humans interact with the natural world: in the exchange of matter and energy, through social institutions, and through cultural components and forms. The publication is still in print and considered valuable by many.

In late 1978, a group of representatives of state resource management agencies and the education community got together to discuss environmental education in terms of what had been learned over the years since the development of **Ekistics**, through license plate grants, federal projects, resource agency programs, and other activities. As a result of this meeting, a new set of goals and objectives were developed, and these, in turn, were written into the 1979-81 county superintendents cooperative **Course of Study**.

In that publication, it was observed that environmental education had instructional implications in a number of discipline areas, and specific examples were pointed out in the various subject matter sections.

The resource agency-eduction committee, which had developed the new set of goals and objectives, felt that further work was needed to produce curriculum and supporting materials which would facilitate the infusion of environmental education into the entire K-12 instructional program. A recommendation to this effect was made to the Secretary for Resources who budgeted $150,000 from fiscal 1979-80 environmental license plate funds for this purpose.

After approval by the legislature, the Department of Education called a meeting of key educators including classroom teachers, administrators, teacher educators, resource management agency personnel, and others who reviewed currently available materials, developed a content outline, and otherwise spelled out in some detail what was needed, and how the final product should be organized. It was agreed that input from both educators and resource management personnel was important through every step of the developmental process, and that the emphasis should be on practicality and usability at all levels.

The Department of Education developed a contract based on the recommendations of this ad hoc advisory commitee, and the Alameda County Superintendent of Schools was the successful bidder.

This proved to be a fortunate choice for a number of reasons. The office had a competent staff of people to do the job, was in close contact with the Bay Area education community, and most important, had the contract to produce the 1981-84 **Course of Study**. This latter circumstance proved to be most fortunate because it enabled staff to develop the environmental education material in tandem with the **Course of Study**, with the result that what was produced became a component of an extension of this key state-level publication.

The guide is based on two major premises:

- Environmental education can serve as an instructional umbrella with a great number of topic areas such as energy and conservation, marine education, outdoor school programs, wildlife resources, soil conservation, historical and recreational resource management, city planning, population growth, nature study, and others, may be addressed in a holistic manner.
- That environmental knowledge, skills, and attitudes cut across all subject matter lines at all instructional levels, and, therefore, environmental education should be seen not as a specific and separate subject, but as a theme which should be infused throughout the instructional program at all levels.

In response to the wishes of the ad hoc advisory committee, the Guide has something of practical value for everyone. For curriculum developers and producers of materials, there is a K-12 curriculum outline. Classroom teachers will find nearly 200 sure-fire learning activities selected for their suitability by their colleagues, and access to hundreds more. Administrators will find a plan for getting an appropriate program underway in their schools, resource management agency people will be able to acquaint educators with information regarding their role in resource management, management problems and issues, and materials and services they can provide.

Although publication of this material represents an important milestone in environmental education in California, we must not fall into the trap of believing that the job is completed with its printing and distribution. What happens next in schools and classrooms throughout the state will be the real measure of success for this work, and we are looking to you for your help.

Rudolph J. H. Schafer, Director
Environmental Energy Education
California State Department of Education

INTRODUCTION

A Point of View

The primary goal of environmental education is to develop citizens who are knowledgeable about the environment and involved in working toward a more liveable future. This goal is based on the following assumptions:

- The environment is not only biophysical; it is also aesthetic, economic, social, and political as well.
- Environmental education must promote an environmental ethic where people are not exploiters of the environment but are stewards concerned with the perservation of all life systems.
- Environmental education must reflect a commitment to future generations, not merely perpetuate the values of the past.
- Environmental education is not a subject, but a synthesis of concepts and skills from all disciplines that relate to the environment.
- "A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends to do otherwise." (Aldo Leopold)

Organization of the Environmental Education Guide

The purpose of this Guide is to provide teachers with background information, program structure, and activities for environmental education. The Guide actually consists of four volumes: K-3, 4-6, 7-9, and 10-12. Each volume is organized around four major content areas of concern:

1. Natural Environment
2. Built Environment
3. Social Institutions and Decision Making
4. Energy and Environmental Resource Management

These areas are addressed in the following ways:

Issues related to each area of concern are examined in an effort to provide educators with background information. While by no means definitive, these statements are starting points for understanding these complex issues.

A chart, **Matching Objectives to Classroom Activities**, states the instructional objectives under each area of concern and describes, in summary, related activities at the four levels (K-3, 4-6, 7-9, 10-12).

Classroom activities are samples of ways in which a teacher can address the instructional objectives. The activities integrate key stages of cognitive development. Instructional techniques are suggested that promote problem-solving skills, values, and attitudes consistent with our role as stewards of planet earth.

Guidelines for **Planning an Environmental Education Program** are for a principal or curriculum coordinator to follow as s/he helps a group of teachers plan their program.

The appendices give an overview of the California resource agencies. This clarifies the unique role of each agency and how the agencies fit together in a joint effort to manage our state's resources. A list of no-cost and low-cost teaching materials available from these resources is included in this section as well as a directory of California resident outdoor education programs.

PLANNING AN ENVIRONMENTAL EDUCATION PROGRAM

19 7 20

An Interdisciplinary Approach to Environmental Education

The purpose of the **Environmental Education Guide** is to help teachers promote better understanding of the diversities and interdependencies of life systems and nurture the skills involved in decision making. This requires a synthesis of concepts and skills that relate to the environment from **all** subject areas. Environmental education is not treated as a separate, discrete discipline, but as an integration of disciplines that results in new ways of thinking about and behaving toward our environment. We, as educators, are, therefore, faced with the challenge of looking at our curriculum in perhaps a new way — one which allows us to consider the entire curriculum as a system for organizing an environmental education program.

As we integrate concepts from environmental education into the curriculum, we face the danger of fostering a nonsequential, "shotgun" approach to program planning. We hope the Planning Chapter will help guide that process in a way that encourages an individual teacher or a staff to choose concepts, objectives, and activities that are related and built upon each other in a comprehensive sequence.

Overview of Environmental Education Planning

This section of the **Environmental Education Guide** is intended to provide schools with a set of procedures for developing an interdisciplinary environmental education program. These procedures are written primarily for the individual(s) responsible for assisting schools in developing an environmental education program. This may be the principal, a curriculum coordinator, resource specialist, or a teacher. The procedures guide a school staff as they:

- Reach agreement on a working definition of environmental education.
- Review their curriculum for the purpose of identifying current environmental education classroom or school activities.
- Adopt environmental education concepts to infuse into the selected curriculum areas.
- Identify the curriculum area(s) most appropriate for infusing environmental education activities.
- Select and implement environmental education classroom activities.
- Assess the effectiveness of their environmental education program.

These procedures may be followed by an entire staff, or by teachers from a selected department, grade level, or grade cluster (K-3, 4-6, 7-9, 10-12). The entire process can be carried out in approximately three 1½-hour sessions.

Finally, these recommended procedures are not conclusive statements on environmental education curriculum planning. They are intended as **suggestions** and have been successful guidelines for planning other curriculum areas. Also, these procedures are **starting points** for developing an interdisciplinary program; they by no means stand alone as a definitive method toward interdisciplinarity. As these procedures are tried out and revised, it is hoped a useful method will evolve.

Reaching Agreement on Environmental Education Point of View

Session I: The staff agrees upon a working definition of environmental education, identifies environmental education activities they currently use, and selects major areas of concern to infuse into the curriculum.

The following procedures are designed to help a school faculty come up with a common working definition of environmental education:

- The group leader begins the first session by describing the purpose and the agenda of the session.
- The leader then distributes a copy of the Point-of-View statement from page 6 of the Guide. This statement serves as a starting

point for discussion, "How do we define environmental education?"

- The leader elicits reactions and modifications from the group as they examine the Point-of-View statement. If only minor changes are suggested, participants can note changes on their copies; if extensive changes are suggested, the group leader may want to record on the chalkboard or newsprint.
- The group then attempts to reach agreement on a common Point-of-View statement which reflects their modifications. The leader may facilitate agreement by using a consensus or straw-vote process. (See the Process Glossary for explanations.)

Now that the group has a working definition of environmental education, they are ready to identify elements of environmental education in their existing curriculum.

- The group leader asks each individual to jot down those learning activities that s/he has done, is doing, or plans to do with students that relate to environmental education. These should be noted as briefly as possible, perhaps by title or a short, descriptive phrase.
- As the participants note activities, the group leader places four pieces of newsprint on the wall. Each piece is titled with one of the areas of concern from the Guide: Natural Environment, Built Environment, Social Institutions and Decision Making, and Resource Management.
- After approximately five minutes, the leader asks the group to stop writing and distributes Issues statements of each area of concern (see Guide, pages 19, 49, 65, and 91). These statements will help guide the group as they categorize their activities.
- The leader asks individuals to call out their activities and identify the area of concern that each activity best fits. The leader records responses on the appropriate pieces of newsprint.

The group has compiled a record of ways in which it already teaches about the four areas of concern, as they consider ways to further emphasize environmental education in their curriculum.

- The leader facilitates a discussion of the four areas of concern referring to the Issues statements, as well as the activities listed under each heading.
- The leader distributes Summary of Activities sheets (see pages 21, 51, 69, and 93) and assists the group as they examine the concepts, the objectives, and the activity descriptions under each area of concern.
- After discussion and clarification, the leader asks the group to reconsider its curriculum and determine which of the areas of concern it would like to emphasize in the future. Some members of the group may wish to strengthen or expand on an idea already emphasized; others may wish to tackle a new idea. The leader encourages debate (see debate in the Process Glossary).
- The leader helps the group agree upon which areas it will infuse into the curriculum. This is to be a group decision — the leader may want to use a consensus or rank ordering process to assist the group (see consensus or rank order in the Process Glossary).

The group has now agreed upon a common Point-of-View statement to use as a working definition of environmental education. It has identified currently used curriculum activities, and has also identified the areas of concern it will address in the curriculum.

Selecting Concepts for Your Curriculum

Session II: The group modifies and selects the concepts under each area of concern that will be infused into the curriculum. Each participant agrees to teach two or three concepts and report back to the group.

The following procedure guides the group as they modify concepts for each selected area of concern:

- The leader describes the purpose and agenda of the session.
- The group forms teams of four to six members. Each team meets around a table (see working in groups of four to six in Process Glossary). Each member has a copy of the Summary of Activities sheet for each of the areas of concern to be infused into the curriculum.

- The leader asks all teams to review concepts, objectives, and activity descriptions for all selected area(s). The leader moves from group to group so that participants have the opportunity to ask questions of clarification.
- The leader then assists the teams as they consider modifications and/or additions.
- After approximately 15 minutes, the leader calls the group back together and elicits proposed changes. These suggestions are recorded on the chalkboard or recorded on newsprint; the leader then helps the group agree on final modifications and/or additions, if any (see consensus or rank order in Process Glossary).

The group now has a satisfactory set of concepts and will select specific concepts to emphasize in their curriculum. They may choose one or several concepts listed under each selected area.

- The group discusses which concepts are most appropriate for its curriculum. They may consider the ages and interests of their students, time constraints they foresee, their own interests and abilities, and the availability of related resources.
- Participants are encouraged to advocate for specific concepts they may think should be included in the curriculum (see advocacy in the Process Glossary).
- After the discussion and advocacy period is over, the leader helps the group reach agreement on which concepts they will include in their curriculum. Once again, the consensus or rank order process may be useful (see Process Glossary).
- This process is repeated for each area of concern the staff has selected.

The group now has a clear picture of the area of concern and related concepts it will infuse into the curriculum. It is now ready to make personal commitments to implement related concepts.

- The group leader prepares the following matrix on the chalkboard or newsprint:

MATRIX I: CHART FOR ELEMENTARY

Teachers' Names and Grade Level	Sam K	Joan 1	Betty 1	Lloyd 2
Selected area of concern and concept				
Natural A	Music	Science	Language Arts	Science
Natural C	Art			Math
Built B	P.E.	Art	Social Sciences	

MATRIX II: CHART FOR SECONDARY

Teacher's Name	Mary	Sam	Tony	Alice
Selected area of concern and concept				
Natural A	U.S. History	World History	Amer. Govt.	Calif. History
Natural C	Calif. History			Calif. History
Built B			Geog.	Calif. History

- Participants have a copy of selected area of concern and concepts. The leader asks participants to identify into which subject area(s) each concept will be infused.
- As participants call out their choices, the leader records the subject area in the appropriate box, or, if by department, the unit or subtopic (see Matrix II).

- When all participants have committed themselves, the leader asks the group to consider the entire matrix. Does the matrix reflect a balanced curriculum, or does it emphasize some subject area and not others? The group may adjust its choices to create a more balanced curriculum.
- Participants then agree to try out one or more activities for the concepts they have each selected and to report back to the group in four to six weeks.
- Optional. Participants gather activities that will teach toward their selected concepts. They use activities from the Guide (pages 21, 51, 69, and 93), suggested activities from Session I, or ideas generated in small groups. The group has modified and selected concepts to infuse into its curriculum. Each participant has then selected concepts to try out with his/her students over a four to six week period.

Assessing Progress

Session III: The group reconvenes to assess progress toward infusing environmental education into the curriculum.

- The group leader describes the purpose and agenda for the session.
- The group divides into teams of four to six; each team meets around a table with two pieces of newsprint.
- Team members identify and record what is going well and why as they try out activities for the selected concepts. The leader moves from group to group, observing and assisting when necessary. Papers are posted.
- Team members then identify and record problems they are having as they try out activities. They list reasons for those problems and post papers.
- The teams are now ready to determine the next step(s) toward infusing environmental education into the curriculum. Given the things that are going well, the problems and the reason for each, what are some next steps? Possibilities may be:

  To continue with current program, with little or no adjustments.
  To gather more activity ideas, based on those that have been successful.
  To focus on solving one or more problems that seem to be major hindrances.
  To try activities from the Guide.
  To gather other resources listed in the Guide (see page 109).
  To schedule an in-service in environmental education.

- The group leader assists the participants as they decide on what specific action to take. S/he helps them outline necessary steps toward that action and divide up responsibilities so that necessary action is taken.
- Dates are set for getting together to review progress. The group has reviewed and assessed its progress toward infusing environmental education into the curriculum; it has also identified any necessary future actions. The procedure outline in Session III can be an ongoing process.

AN INDIVIDUAL APPROACH

The following procedure is designed for an individual teacher who plans to infuse environmental education into his/her curriculum.

1. Refer to the environmental education curriculum matrix on page 13 of the Guide. This matrix will help you select the appropriate subject area(s) and related concepts for teaching environmental education in your classroom.

2. Subject areas are listed across the top of the matrix.

***COURSE OF STUDY GOALS AND OBJECTIVES**

ART	BUSINESS EDUCATION	CONSUMER/ HOME EC.	DRAMA/ THEATRE	ENGLISH LANG. ARTS/ READING	FOREIGN LANGUAGE	HEALTH	INDUSTRIAL ED.	MATH	MUSIC	PHYSICAL EDUCATION	SCIENCE	SOCIAL SCIENCE

Choose the subject area(s) into which you will infuse environmental education.

3. Under each subject area you will find numbers which refer to objectives in the **Course of Study**. Locate each numbered objective for the selected subject area(s) by referring to page 15. Read the selected objective. If they are appropriate for your students, refer back to the matrix.

SCIENCE
1.2 1.3

4. You will note that the **Course of Study** objectives are matched to environmental education concepts, which are listed down the left side of the matrix.

NATURAL ENVIRONMENT	A. The natural environment functions according to patterns of established relationships between living and nonliving things.
	B. All species of plants and animals live in habitats and many species exploit more than one habitat in order to meet their needs.
	C. The sun is the ultimate source of energy which all life on earth needs in order to exist.
	D. The environment is being shaped continually by naturally & humanly produced forces which can alter the balance of conditions & lead to changes in the plants & animals which are able to exist there.

Read those environmental education concepts that correlate with the numbered **Course of Study** objectives noted above. If these environmental education concepts are appropriate for your students, you are ready to select objectives and activities for your curriculum.

5. Environmental objectives are listed under the four major areas on the following pages:

   Natural Environment, page 20

   Built Environment, page 50

   Social Institutions and Decision Making, page 68

   Energy and Environmental Resource Management, page 92

Refer to the appropriate pages, locate the selected concept(s). Choose one or more objectives under each selected concept.

Review activities which are matched to those objectives. Select activities to try with students (or gather activities from other sources).

After trying out activities, identify what went well and what were some of the problems. Modify your program accordingly.

If you wish to infuse environmental education into other subject areas, repeat these procedures.

ENVIRONMENTAL EDUCATION CONCEPTS

COURSE OF STUDY GOALS AND OBJECTIVES

		ART	BUSINESS EDUCATION	CONSUMER/ HOME EC.	DRAMA/ THEATRE	ENGLISH LANG. ARTS/ READING	FOREIGN LANGUAGE	HEALTH	INDUSTRIAL ED.	MATH	MUSIC	PHYSICAL EDUCATION	SCIENCE	SOCIAL SCIENCE
NATURAL ENVIRONMENT	A. The natural environment functions according to patterns of established relationships between living and nonliving things.												1.2 1.3	
	B. All species of plants and animals live in habitats and many species exploit more than one habitat in order to meet their needs.													
	C. The sun is the ultimate source of energy which all life on earth needs in order to exist.													
	D. The environment is being shaped continually by naturally & humanly produced forces which can alter the balance of conditions & lead to changes in the plants & animals which are able to exist there.	1.1						3.1		3.4		5.3	4.3	1.2
BUILT ENVIRONMENT	A. Built environments depend on resources from the natural environment for survival.			3.1										
	B. The design and maintenance of built environments have both reflected and influenced the values, ethics, and lifestyles of the inhabitants.			3.2 1.1 1.2			3.2		4.3			5.4		4.3
	C. Built and natural environments function in similar ways and share many basic needs for survival and growth.							1.4						
SOCIAL INSTITUTIONS AND DECISION MAKING	A. Environmental problems transcend political entities, state and national boundaries & cultural differences.						3.1							4.1
	B. The goals for every society include economic prosperity which is based, in part, on natural resources.		4.4											
	C. Individuals & private groups within our society & independent of the major social, economic, & political decision-making institutions play an important role in developing public awareness of environmental issues & in monitoring public and private activities in relation to the environment.	4.4		3.3	1.2 4.2	6.2		3.3						3.1
	D. Educational institutions & communications media are potential sources for the creation of public awareness of environmental issues.							2.3			4.3			
	E. Environmental law is intended to regulate use of the environment for present & future generations.							2.1 3.2						
RESOURCE MANAGEMENT	A. There are a number of historic & present day models which can be used in developing management programs.													
	B. Conservation is the most immediate way of increasing the real supplies of a natural resource. Conservation practices focus on more efficient uses of natural resources.													
	C. Some resources are renewable & can be maintained so they will provide consistent & continuous supplies of resources as they are needed.								4.2					
	D. To understand the role of the resource agency & its departments in maintaining the productivity of our natural resources into the future.													

PROCESS GLOSSARY

Advocacy is a process that can be used with a group to help discuss the pros and cons of a series of options. The rules are:

- Individuals have 30 seconds to lobby for or against the importance of an option.
- An individual may have additional 30-second periods as long as each period is preceded by someone else's 30 seconds.

Advocacy provides a group with a structure to assist individuals to hear each other. The leader explains the rules, suggesting that individuals name the item they are promoting or not promoting. S/he assists individuals to advocate and monitor the time.

Consensus

Consensus is a process that can be used with a group to reach maximum agreement among its members. Agreement is usually made by a group among a number of options. The leader assisting a group to reach consensus makes sure that everyone understands the options being considered. S/he asks for suggestions as to which options the group wants to take on. These options are noted. S/he points out each option asking the question, "Is there anyone who can't live with the group selecting this option?" If no one objects, the group has reached consensus. If some members object, the leader moves to a next option. This continues until one or two options have only one or two objectors. The leader can ask the one or two what needs to be done to enable them to live with the option. The leader checks out the change with the group.

Curriculum Rating Process

This process may be used to select the curriculum areas in which to infuse environmental education. Individuals are asked to rate the potential for infusion for each of the identified curriculum areas according to this scale.

3-Excellent Potential 2-It's Possible 1-Very Improbable, Forget It

Individuals record their ratings on a chart.

	Person #1	Person #2	Person #3	Person #4
LANGUAGE ARTS	1	1	1	1
SCIENCE	3	3	2	1
SOCIAL SCIENCE	2	3	3	2

Scores are totaled; areas receiving high scores are the better candidates for infusion.

Rank Order

Rank order is a process that takes individual orderings of a set of items and accumulates the ranking to obtain a group ordering. The items to be ordered are labeled by a letter — A, B, C, etc. Each individual is given small 3" x 5" sheets of paper. Each paper is labeled A, B, C, etc. Each person is directed to order his or her papers according to importance. S/he is then asked to number the papers 1, 2, 3, etc.; 1 is the most important.

All the A's, B's, C's, etc., are collected. The numbers on each of the A's are added, then the B's, then the C's, etc. The letter of the option receiving the lowest total number is the most important.

Working in Groups of Four to Six Persons

Rather than work with staff in large group discussion, it may be helpful for groups to work in smaller groups in discussion and decision making. The leader can ask the subgroups to work on tasks of reviewing information, developing options, and forming decisions.Then s/he can collect items from each group and record them on the chalkboard or butcher paper. This helps the group review its comments and reach a decision.

COURSE OF STUDY OBJECTIVES THAT RELATE TO ENVIRONMENTAL CONCEPTS

ART

1.1 To develop awareness of color, shapes, and textures in human-made and natural environments.
4.4 To demonstrate skill in using creative expression as a means of bringing about constructive action to solve social and environmental problems.

BUSINESS EDUCATION

4.4 To develop an understanding of business economics.

CONSUMER/HOME ECONOMICS

1.1 To develop an awareness of personal values in relation to different lifestyles.
1.2 To develop an awareness of personal resources in relation to different lifestyles.
3.1 To develop an understanding about the relationship of housing choices to aesthetic, social, and environmental issues.
3.2 To understand how personal lifestyle choices affect the quality of the environment.
3.3 To understand how community, state, and federal resources are used to provide services within a community.

DRAMA/THEATER

1.2 To develop problem-solving skills through creative drama and improvisation.
4.2 To become aware of the role of drama/theater in influencing public opinion in areas of merchandising, human relations, and politics.

ENGLISH LANGUAGE ARTS/READING

6.2 To develop skills for making critical analyses of written materials and media presentations.

FOREIGN LANGUAGE

3.1 To understand the attitudes and values, customs, traditions, and taboos which make up the culture.
3.2 To become familiar with the environments in which cultural groups have developed.

HEALTH

1.4 To develop strategies for daily living that build self-acceptance and reduce stress and anxiety.
2.1 To understand the causal factors of diseases or other physical disorders and develop strategies for preventing, treating, or controlling these malfunctions.
2.3 To develop skills for evaluating health information, products, and services.
3.1 To understand the relationship between ecological balance in the environment and people's mental, social, and physical well-being.
3.2 To understand the types of resources needed to protect the health of people in local, state, national, and world communities.
3.3 To develop awareness of the personal and community resources that can be used in accident prevention and in meeting emergency situations.

INDUSTRIAL ART

4.2 To develop an awareness of the basic economic structure of our industrial society.
4.3 To develop an awareness of the relationship between environment and industry.

MATHEMATICS

3.4 To develop skills for recognizing and using geometric figures in the environment.

MUSIC

4.3 To understand how cultures and historical periods influence musical styles and forms.

PHYSICAL EDUCATION

5.3 To understand the impact of various recreational activities on the environment.
5.4 To value leisure as a complementary balance to work.

SCIENCE

1.2 To be aware of order and beauty in the natural environment.
1.3 To appreciate and respect all living organisms (including self) and their place in the environment.
4.3 To demonstrate an understanding of the ways in which science and technology affect individual lifestyles and social/cultural development.

SOCIAL SCIENCE

1.2 To understand how societies develop in diverse physical and social settings and meet the needs and desires of their members.
3.1 To understand differences and similarities of the value systems held by different cultural and social groups in the American society.
4.1 To develop an awareness of social change in the past and present and to anticipate future change.
4.3 To participate in social action projects that are of benefit to the community.

Classroom Activities

Natural Environment

The classroom activities in this section are samples of ways in which teachers can address the instructional objectives. These activities help students to understand the connections between the biological and physical worlds, the unique characteristics of habitats, the fundamental importance of the sun, and the effects that the ecosphere has on natural and human forces.

Built Environment

The classroom activities in this section assist students in understanding the dependency of the Built Environment on the Natural Environment, the evolution of the Built Environment and its influence on societal values and stresses, and that the Built and Natural environments are intertwined through an intimate cause/effect relationship.

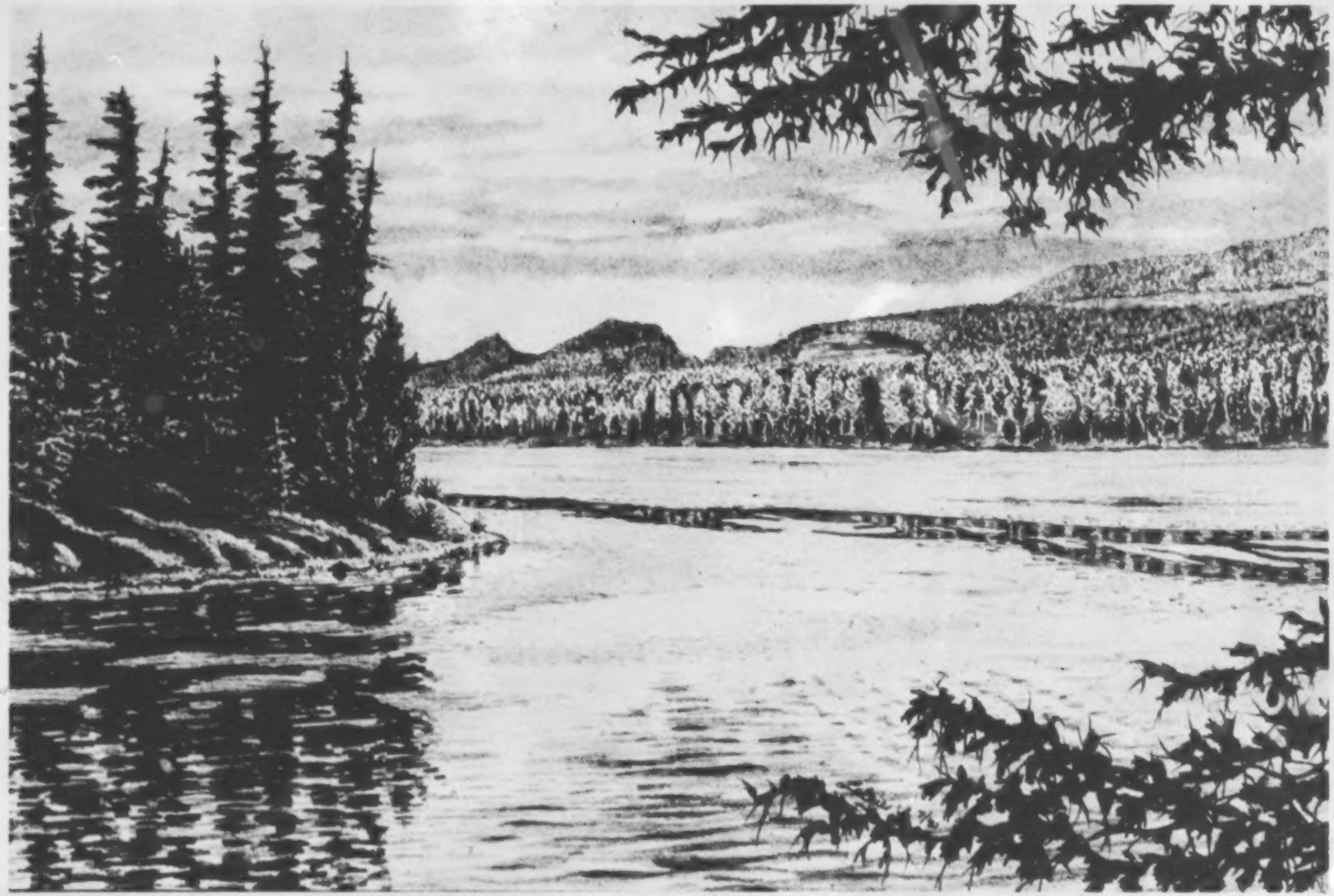
Social Institutions and Decision Making

The classroom activities in this section are samples of ways in which teachers can assist students to understand that environmental problems transcend political entities, state and natural boundaries, and cultural differences, and that individuals, institutions, and private groups within our society play an important role in developing public awareness of environmental issues.

Energy and Environmental Resource Management

The classroom activities in this section are samples of ways in which students can understand the importance of conservation, the costs and benefits of continuously renewing resources, and how we manage our resources in the state.

Natural Environment Activities



NATURAL ENVIRONMENT

Issues

The part of the Natural Environment of planet earth where all known life systems exist is a relatively thin belt of water, land, and atmosphere called the ecosphere. The ecosphere is comprised of separate, yet interrelated communities of living things called ecosystems, each with its unique mosaic of plants, animals, bacteria, and viruses. The physical and chemical environment of each community determines what can survive there; this intricate web of relationships between the biological and the physical world is fragile and continually changing.

Chemical elements, such as carbon, hydrogen, oxygen, and nitrogen, are essential nutrients for all life forms. They circulate through life systems, continually replenishing the environment and regulating the abundance of life.

Water is a principal means of transport for nutrients traveling throughout the environment. Run-off water from precipitation carries suspended and dissolved elements from the land to the oceans. Radiant energy from the sun lifts them, through evaporation, to be dispersed by wind action. This is the hydrologic cycle, the major transport system for circulating ingredients throughout the ecosphere.

An alteration in the physical or chemical composition of a natural community results in concomitant alterations in the biological compositon. Usually, these changes are gradual — a lake may slowly fill in to become a marshland, then a bog, and climax as a meadow.

Sometimes, however, the process of change may be more sudden and, hence, immediately destructive. A volcanic eruption is an example of a sudden destructive change caused by natural forces. Filling in coastal wetlands for land development is less violent but is an equally destructive change caused by human forces. Agriculture is another human force that affects a natural community, this time by preventing the natural evolution of the land from taking place. Because the tendency to diversify is held in check, agricultural lands become susceptible to disease-carrying bacteria and the invasion of pests. This condition is compounded as crop strains are further refined and farmers plant increasingly specialized monocultures.

Landfill and agricultural practices are two ways that human activity directly affects the ecosphere. Other ways are more insidious, such as industrial pollution, which enters the hydrologic cycle and results in acid rain. It is becoming increasingly apparent that humans must consider the long-range effects of their actions upon the ecosphere before the fragile web of life systems is irrevocably harmed.

Four concepts have been identified to help students understand life systems. The first is concerned with the interconnectedness between the biological and the physical worlds. The second considers the importance of habitats and their unique characteristics. The third stresses the fundamental importance of the sun. The fourth examines natural and human forces which affect the ecosphere.

NATURAL ENVIRONMENT

MAJOR CONCEPTS	OBJECTIVES
A. The natural environment functions according to patterns of established relationships between living and nonliving elements.	1. To understand that all living things play roles and have functions in relation to maintaining and renewing the natural environment. 2. To understand the web that binds together the biological community and the physical world within and between ecosystems in different natural settings. 3. To understand how biological communities of plants, animals, and microorganisms interact within different environments.
B. All species of plants and animals live in habitats and many species exploit more than one habitat in order to meet their needs.	1. To understand that different species of plants and animals depend on specific types of habitats for survival. 2. To understand that each system — water, land, air — contains resources that are important for the maintenance of life.
C. The sun is the ultimate source of energy which all life on earth needs to exist.	1. To understand how the energy radiated by the sun is used on earth to maintain ecological processes. 2. To understand that energy can be stored by plants and converted through natural processes into large scale energy sources, such as petroleum, natural gas, and coal. 3. To understand that energy can neither be created nor destroyed. It is in a constant state of flux.
D. The environment is being shaped continually by natural and human forces which alter the balance of conditions and lead to changes in plant and animal populations.	1. To understand the factors which determine the variety and abundance of life that can be supported within a geographic area. 2. To understand how the biological community of plants, animals, and microorganisms adapt to the environment through changes in genetic composition and population size. 3. To understand how humans manipulate the environment and cause changes in the balance of conditions. 4. To understand the natural forces that continually shape the environment.

NATURAL ENVIRONMENT OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand that all living things play roles and have fuctions in relation to maintaining and renewing the natural environment.	Students take a mini-safari to find out what lives in and around a variety of microhabitats.	Students build a model food pyramid with their bodies.	Students take a census of an outdoor site "job descriptions" for the organisms observed.	Through guided imagery, art, and language arts, students assess the results of the removal of one element from an ecosystem.
	2. To understand the web that binds together the biological community and the physical world within and between ecosystems in different natural settings.	Class sets up a mini-ecosystem in an aquarium.	Students sit in a circle and pass a ball of yarn to form a "web of life."	Students calculate the amount of H_2O released from a leaf through transpiration.	Student committees present mixed media shows illustrating the ecosystem of a nearby area.
	3. To understand how biological communities of plants, animals, and microorganisms interact within different environments.	Students compost their food waste.	Students' lunches are recycled in the classroom by common decomposers.	The decomposing role of sowbugs in the forest ecosystem is studied.	Students collect and arrange specimens in a terrarium.
CONCEPT B	1. To understand that different species of plants and animals depend on specific types of habitats for survival.	Students experiment to determine how plants will grow when subjected to different "types" of water.	Students play a cooperation game modeling systems interaction.	Students take a census of two adjacent natural communities and the ecotone between them.	Students make a mural of the water cycle. They interject disruptions in the environment.
	2. To unoerstand that each system - water, land, air - contains resources that are important for the maintenance of life.	Students hang Vaseline coated paper to collect particles in the air.	Students model a resource balanced ecosystem in a game format.	Students do a worksheet activity on the marine food chain.	Students express opinions on ocean resource issues through debate, language arts, and/or graphics.
CONCEPT C	1. To understand how the energy radiated by the sun is utilized on earth to maintain ecological processes.	Students sprout beans in a sunny area and a dark area to compare beans from each area.	A series of experiments are conducted on the use of sunlight by plants.	Students test uncovered and foil covered coleus leaves for starch production.	Students trace a favorite food back to its ultimate source and trace the use of energy in supplying the food.
	2. To understand that energy can be stored by plants and converted through natural processes into large scale energy sources such as petroleum, natural gas, and coal.	Students are introduced to plants (foods) that give them energy.	Students simulate natural oil deposits by starting a compost pile.	Students prepare ano perform a role-play activity on energy transfer.	Teacher leads the class in an extended role-play, modeling the process of fossil fuel generation.
	3. To understand that energy can neither be created nor destroyed—it is in a constant state of flux.	Students participate in a cooking activity to investigate physical and chemical changes.	Students use thermometers to measure heat in classroom.	Students read several personal statements on energy as a stimulus to expanding their own perspectives and writing their own poems.	Students examine the role the sun has played in the culture, past and present.
CONCEPT D	1. To understand the factors which determine the variety and abundance of life that can be supported within a geographic area.	Students investigate different sites in an outdoor area for heat, wind, moisture, etc.	Students experience directly the dramatic results of disruptions in an ecosystem.	Students find the locations outdoors, which are warmest, coolest, brightest, etc. (see level 1).	Through experiments and observation games, students make judgments on probability and desirability of trees in the environment.
	2. To understand how the biological community of plants, animals, and microorganisms adapt to the environment through changes in genetic composition and population size.	The group hunts for colored "worms" in two habitats and compares results.	Students role-play deer in a forest by looking for food, water, and shelter. A rock/paper/scissors game.	Students design animals or plants and explain the reasons for the organisms survival or extinction.	Students research local endangered species, analyze the problem, and prepare action statements.
	3. To understand how humans manipulate the environment and cause changes in the balance of conditions.	Students take a walk to examine the micro-habitats on and near walls.	Students simulate chemicals causing environmental changes and try to control their use and abuse.	Students set up indicators for CO and O^3 in several outside locations.	Students rate environmentally sensitive practices on a values continuum.
	4. To understand the natural forces that continually shape the environment.	A model stream table is set up. Students manipulate water flow and land forms.	Students write stories about, and act out, the natural forces which shape our environment.	Students construct a model of geological evolution — before and after demonstration.	Students assess the posssible causes of global glaciation and write a disaster film script.

IS ANYTHING HAPPENING HERE?

DESCRIPTION

Students take a census of an outdoor site and write "job descriptions" for the organisms observed.

OBJECTIVE

A-1. To understand that all living things play roles and have functions in relation to maintaining and renewing the natural environment.

PURPOSE

To illustrate the functions of living things in maintaining and renewing the natural environment.

Time
Site visit: 15 minutes
Introduction: 20 minutes
Activity: 45 minutes at site
45 minutes in classroom

Where
Classroom, outdoors with a variety of vegetation

Topics
Ecosystem, ecological niche, diversity, food chain

Materials
Community tally sheets, one for each small group; map of site—individual maps later to be compiled on one large map, or one large map brought to site

LEAD-UP/PREPARATION

Discuss:

Q: What must these organisms have in order to survive? (O_2, H_2O, space, food, a method for waste removal, shelter, etc.)

Acquaint students with "jobs" in the natural community (see Tally Sheet below).

COMMUNITY TALLY SHEET

Plant/Animal Description	Job or Role	Home address (check one) Basement/Street Level/High Rise

Jobs

(A) Aerators: Animals which help keep the soil loose so that water can flow more easily and plants can grow.
(GC) Garbage Collectors: Animals which help the community by removing or breaking down dead materials.
(FP) Food Producers: Living things in the community which can take in the sun's energy and turn it into energy forms which other residents can eat.
(SB) Soil Builders: Plants which are breaking down rocks into finer pieces which will then become part of the soil.
(T) Transporters: Animals which move things from one part of the community to another part. Seeds often ride with these transporters.
(AC) Air Conditioners: Things which make the air breathable for others in the community.
(PC) Population Controllers: Animals which help control the numbers of residents in the community so that it doesn't get too crowded.
(F) Fertilizers: Community dwellers who help make the soil a better place to grow by adding wastes or by reworking the materials.

Establish clearly what is meant by levels—basement: underneath the ground; street level: on the surface; and high rise: above the surface in a shrub or tree or in the air.

ACTIVITY

Step 1

Divide into teams, each with a tally sheet and individual maps (if they are to be used).

Step 2
Direct students to complete their inventories on the tally sheets and maps. Students should describe plants and animals. *Do not take samples!*

Step 3
If individual maps have been used, compile all notations on the large map (it could be drawn on the chalkboard).

Step 4
Discuss:

Q: Are there any organisms that "moonlight"; i.e., have more than one job?
Q: Are there any organisms with no jobs?
Q: Are all the necessary jobs filled?
Q: Are there any locations with no inhabitants?
Q: What did you discover that surprised you the most?
Q: What would happen to this community if all the population controllers were removed? The fertilizers?

- Ask each student to make a list of ten things that are happening at the site.
- Have each student share his/her list with another student. They may each modify their lists as they discuss.
- Direct each student, using his/her list, to write a paragraph on "What Is Happening Here."

FOLLOW-UP

1. Construct a food web by using the organisms observed on the chalkboard, in a mural, or with the students playing the part of the organisms.
2. Consider the effect of humankind on the functioning of the community.
3. Assign teams different activities from the community to dramatize. See if the class can guess the activity from the dramatization.

Adapted from Sunship Earth

LEAF TRANSPIRATION

DESCRIPTION

Students will calculate the amount of H_2O released from a leaf through transpiration.

OBJECTIVE

A-2. To understand the web that binds together the biological community and the physical world within and between ecosystems in different natural settings.

PURPOSE

To illustrate the exchange of matter between the living and nonliving environments.

Time First day: 20 minutes Second day: 45 minutes	**Where** Classroom and/or school yard
Topics Plants, water	**Materials** Per person or team: Small plastic bags, with twist or string securer; small pebble, graduated cylinder (can be shared), flour (optional)

LEAD-UP/PREPARATION

1. Select a tree or group of trees or shrubs which will be undisturbed overnight. If this is not possible, plants in the classroom can be substituted.
2. Review the use of the graduated cylinder.
   - Keep the plastic ring near the top to prevent breakage if the cylinder gets knocked over.
   - Measure from the bottom of the meniscus.
3. Discuss what is happening in a leaf.
   Q: What are some of the activities that go on in a leaf?

continued

Q: Do any of these activities produce substances released by the leaf?

Q: If we were to catch the substances released by a leaf, what do you think we might catch?

ACTIVITY

Step 1

Direct each student or student team to tie a labeled plastic bag around a leaf on a tree. Secure it tightly. A small clear pebble weights the bag so it hangs down and the water collects rather than runs out of the bag.

Step 2

After 24 hours, carefully remove the plastic bag so none of the water is spilled, and measure the volume of water collected with a graduated cylinder.

Step 3

Discuss or have the students answer the following questions:

Q: Today your bag contained water. Where did that water come from?

Q: How much water did the leaf transpire (give off) in 24 hours?

Q: Did every leaf transpire the same amount of water?

Q: What factors do you think might influence how much water a leaf transpires?

Q: When you step out of a swimming pool into the air, do you feel warmer or cooler?

Q: The evaporation of the water from your body causes cooling of your body and warming of the air around you. What do you suppose happens to the temperature of the air around a tree from which water is evaporating?

Q: Have you had any experiences which would support this idea?

Q: How do you think the temperature and humidity would differ in a forested area as compared to a nonforested area near the same location?

Q: How might the process of transpiration affect other organisms in the community?

FOLLOW-UP

1. Compare transpiration rates in daylight hours, hours of darkness, and cloudy days as contrasted with cloudless bright days. Try to explain any differences.
2. Conduct experiment again comparing two rinsed, similarly-sized leaves on the same plant. Dust one with flour before securing the bag. Discuss differences and relationship to pollution.

Adapted from *Project Learning Tree*

SOW BUGS AND SOIL

DESCRIPTION

Sow bugs (rolypolies) are crustaceans that live in cool, dark, moist places in forest ecosystems. This activity shows that sow bugs contribute to the forest litter by digesting leaves and by producing litter of their own in the form of droppings and their own dead bodies.

OBJECTIVE

A-3. To understand how biological communities of plants, animals, and microorganisms interact within different environments.

PURPOSE

To illustrate the role of sow bugs in recycling matter between plant material and organic matter in forest soils.

Time	**Where**
15 minutes per day for 5 days 30 minutes on day 6	Collecting outdoors where there is leaf litter Classroom
Topics	**Materials**
Ecosystem, wildlife, food chain	Per student: 2 containers, 20 sow bugs, plant materials

LEAD-UP/PREPARATION

Locate good sow bug collecting sites so you can refer students to specific locations.

ACTIVITY

Step 1

Ask students to collect sow bugs by looking under logs, stones, and leaf litter in wooded areas. Encourage students to use care in gathering sow bugs, doing as little damage as possible to the environment.

Step 2

As students gather the sow bugs, ask them also to collect several fallen leaves and other decaying plant material of different kinds (such as fallen oak, maple, alder, and birch leaves; fir and pine needles; and grass), and place each kind of plant material in a closed container with several (eight to ten) sow bugs. Remind the students to leave small air holes so the sow bugs can breathe!

Step 3

At the same time, the students also should establish control containers which have plant material but no sow bugs. Plastic bags filled with air make excellent containers. There should be plenty of moisture in each container; if plastic bags are used, the air supply may need to be renewed daily. Do not keep any containers in the direct sun.

Step 4

Ask each student to keep a daily record of changes in the container. He or she should rate:

- Changes in sow bug population
- Size of sow bugs
- Type of plant material eaten
- Any other observations

Step 5

After a week, students should compile their data.

Q: Do sow bugs have food preferences?

Q: Under what forest conditions would you expect to find the greatest number of sow bugs?

Q: How do the containers with sow bugs differ from the control containers?

Q: What function do the sow bugs serve in the forest?

continued

Q: What other ways might sow bugs contribute to the forest ecosystem? (Food for other animals.)

Step 6
Carefully return sow bugs to their usual habitat.

FOLLOW-UP

Draw a food web that includes sow bugs. Write poems about sow bugs.

TROUBLE-SHOOTING

Be certain sow bugs are well taken care of. They need moisture, air, and must not get too hot. It is important that teachers set an example of care for all living creatures.

Adapted from *Project Learning Tree*

ECOTONE EXPLORATION

DESCRIPTION

Students go outside and take a census of two adjacent natural communities and the ecotone in between.

OBJECTIVE

B-1. To understand that different species of plants and animals depend on specific types of habitats for survival.

PURPOSE

To examine an ecotone and compare organisms in adjacent natural communities with organisms in the ecotone.

Time 1 hour	**Where** Outside area where two natural communities meet (such as a lawn bordered by trees)
Topics Ecosystem, diversity, life cycles	**Materials** Per team of 2 or 3: 1 string approximately 2m long; data board (large tablet or butcher paper on hard surface); felt markers; tape

LEAD-UP/PREPARATION

Discuss the term "ecotone": a transitional zone between two adjacent communities containing species characteristic of both as well as other species occurring only within the zone (as defined in *Webster's New World Dictionary*, 1980). Ask students to give examples (e.g., where a forest borders a meadow) and name animals that might be present. Locate an ecotone for activity. Determine boundaries.

ACTIVITY

Step 1

Divide class into teams of two or three and pass out string to each team. Define boundaries.

Step 2

Distribute teams so that one-third are in one natural community, one-third are in the adjacent community, and one-third are in transitional area.

Step 3

Instruct students to place the string in a circle on the ground and take a "census" by collecting samples of plants and animals found within the circle.

Step 4

Have data board nearby, with the three study areas clearly labeled. Students record, by drawing or taping what they find, on data board.

Step 5

As students finish ground census, ask them to observe and record plants and animals that live above ground level in their community.

Step 6

Regroup your class around the data board. Discuss:

Q: What plants and animals were prevalent in each community?

Q: Were any found in *both*?

Q: What plants and animals were prevalent in the ecotone?

Q: Were any plants or animals found *only* in the ecotone?

Q: Why can some organisms live in more than one community?

Q: Choose an organism that was found in one community *and* the ecotone. Why is this organism found in both? How are its needs met in each area?

FOLLOW-UP

1. Have each student write a short description of an area made up of two different natural communities, including plants and animals. Exchange descriptions.
2. Have each student now draw an animal or plant that might be found in the ecotone between the two areas described. Allow time for students to share their drawings and ideas, including how the organism is able to survive there and how it meets its needs.
3. Have students define marine ecosystems and ecotone vocabulary (e.g., beach, intertidal, shelf, slope, abyss, benthic, motile, sessile).

WHO EATS SEAWEED?

DESCRIPTION

Students do a worksheet activity on marine food chain, followed by construction of two group bulletin boards or murals.

OBJECTIVE

B-2. To understand that each system—water, land, air—contains resources that are important for the maintenance of life.

PURPOSE

To illustrate the importance of resources from the sea in maintaining life on land.

Time Two 15-minute periods on different days	**Where** Classroom
Topics Oceans, food chain, ecosystem	**Materials** 1 per student: copy of article—worksheet. Optional: *National Geographic* "Sequoias of the Sea," August 1970. *Ranger Rick*, "Seaweed . . : Useful Plants of the Sea," 4:44-47, 1970. Drawings, pictures, and/or photos of seaweed.

LEAD-UP/PREPARATION

1. Prepare a bulletin board or a piece of butcher paper for displaying labels from products with seaweed ingredients.
2. Discuss:
   Q: What is seaweed?
   Q: Where can seaweed be found? (What parts of the ocean?)
   Q: What do you think seaweed might be used for?

continued

ACTIVITY

Step 1

Read the article on marine algae. An oral reading technique that may be helpful is to read aloud a paragraph or two. Have students turn their papers over and ask them specific content questions from the paragraphs that were read. After the next paragraph is read, reverse roles and let the students ask the teacher the questions.

Step 2

Divide the students into teams of three or four to complete the worksheet without referring to the article.

Step 3

Appoint two or three "resource students" with access to the article. Correct the worksheet together. If there is disagreement on an answer, refer to the resource students for clarification.

Step 4

Discuss:

Q: What might happen in the future in regard to seaweed? (It could die from pollution; it might be used for food; we might find other uses for it; we might find ways to grow and harvest it more easily.)

Q: What pros and cons can you state for seaweed farming? (It is inexpensive to grow, but expensive to harvest.) What reaction might people have to eating seaweed or seaweed products? (They could be repulsed by its appearance, or even by the idea of eating seaweed extracts if the smell or appearance of seaweed has been unattractive in the past.)

Q: What part of the seaweed is used? Can you point it out on your drawing?

Step 5

Write the commonly used names for seaweed *products on the board for the students to copy.* (Get names of seaweed ingredients.)

Step 6

Ask students to bring in labels from products with seaweed ingredients for the bulletin board display.

FOLLOW-UP

1. Construct a mural showing relationships between kelp and other organisms in the sea and along the shore.
2. Bring in some seaweed crackers or candy for all the children to sample (available at a Japanese grocery).
3. Make algae prints from fresh seaweed. Docks or pilings are good sources.
   - Float the seaweed in basin of water.
   - Bring piece of heavy paper or index card and place it underneath the seaweed; spread the seaweed on the paper and remove from the basin.
   - Arrange the ends of seaweed with a watercolor brush.
   - Cover the seaweed with wax paper.
   - Place the seaweed, white paper, and wax paper in folded newspaper.
   - Press between books and other heavy objects.
   - Change the newspaper once a day for about four days until white paper and seaweed are dry. The seaweed will usually adhere to the paper. If not, touch up loose edges with a little white glue.

Article: Who Eats Seaweed?

Have you eaten any seaweed today? You may have if you ate some ice cream or cake frosting. You drank some too if you had chocolate milk. Your father put seaweed on his face if he used shaving cream this morning. So did your mother if she rubbed lotion on her hands.

Many things around your home contain seaweed. You can't see it, but it's there. A little bit of it in chocolate syrup stops the chocolate from settling to the bottom of your glass of milk. It makes ice cream, shaving cream, and hand lotion smoother and creamier.

Where does the seaweed come from? Let's find out by exploring a beach along the rocky Pacific Coast. A good time is right after a storm. The strong winds and currents have torn loose many seaweeds that grow out in the water. High waves have carried them to the beach, where they have been thrown up in great tangled piles. One of the strangest seaweeds in the piles is the giant bladder kelp. It grows in deep water and may reach the height of a six-story building! Since it can add up to two feet (60 cm) a day to its length, it is the fastest growing plant in the world.

There are many kinds of kelp. All are brown-colored and grow anchored to the rocky ocean floor by holdfasts (roots). Kelp cannot live where the water gets so deep that the sunlight does not reach their blades. Without sunlight they cannot perform photosynthesis.

Kelp grows best in cold water, so it is found in great numbers only in temperate waters in both the northern and southern hemispheres. In these waters it forms great "forests."

There is no mistaking a sea palm in the pile of debris. It looks like a tropical palm tree, except that it's only two feet (60 cm) tall. This seaweed grows far out on the rocks where the Pacific waves hit the hardest. When a wave hits, the sea palm bends back in the white foam. But its stipe (trunk) is tough, and it bounces back again.

Most of the other seaweeds that live at the ocean's edge stand up only when covered with water. The water supports them just as it holds you up when you float. Some seaweeds have small balloons on their blades to give them extra lift. These bladders are filled with gas made by the plant.

When the tide goes out, these seaweeds fall over and lie limply on the rocks. Then life on the rocky shore slows down. Those seaweeds not in tide pools must be able to survive several hours of hot, drying sunshine. During this time many creatures, such as crabs and sea stars, stay wet and cool under the seaweed.

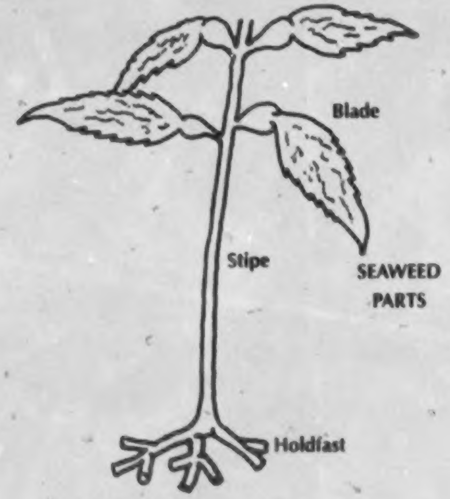
Sea lettuce looks good enough for a summer salad. It is one of a number of green seaweeds that grow best in places where the ocean is quieter and warmer. Some others look like long stringy hair, ribbons, or grass. They can be found in the upper tidepools along the rocky shores. South and along the Gulf Coast, they grow around breakwaters, docks, and pilings. A common place to find them is on boat bottoms.

Seaweeds are an important part of the ocean community. Many kinds of sea creatures find shelter and food among them. For example, in the kelp "forests," small fish and shrimp hide from hungry predators within the tangled maze. Animals such as hydras, turban snails, and sea slugs live on the blades. Sea stars, clams, crabs, and worms seek shelter among the twisting holdfasts. Most importantly, the seaweeds make oxygen and food for all the sea animals.

But now, piled up on the beach, the seaweeds are part of another community. As they begin to rot, they attract thousands of tiny shrimp-like creatures called beach hoppers. The hoppers and small crabs feed on the dead plants. They, in turn, attract shore birds that flip over pieces of seaweed looking for them.

Seaweeds are important to humans as well as to the ocean community. Several kinds are harvested. In the kelp "forest" the top few feet of the plants are cut off every so often. Seaweeds are processed into powder or liquid form and added to many paints, cosmetics, medicines, and foods.

So now you can ask someone, "Have you eaten any seaweed today?" They will probably say, "No!" but they may be wrong!



STUDENT WORKSHEET

Name Date ______________

Directions: Use the article in looking up correct answers to these questions:

1. What are four uses for seaweed in your home?

____

____

____

____

continued

NATURAL ENVIRONMENT

2. What is unusual about the giant bladder kelp?

____

____

3. Why wouldn't you find kelp near Florida?

____

____

4. How would you recognize a sea palm?

____

____

5. What are means of support for sea plants?

____

____

6. What are ways that seaweeds help sea animals?

____

____

7. What are three parts of seaweeds?

____

____

____

8. What dangers are seaweeds and other forms of sea life facing?

____

____

____

9. Complete these sentences:

________________ is the part of the kelp that secures (attaches) it to the rock, etc.

________________ is the "trunk" of seaweeds.

________________ is the leaf-like part of seaweeds.

________________ are sacks filled with gas which hold up the plants.

________________ are leaking pollution into the sea and seaweed is being affected.

________________ are animals that swim around through seaweed looking for other animals to eat.

STUDENT WORKSHEET ANSWERS

1. List four uses for seaweed in your home:
   (a) Shaving cream ingredient
   (b) Hand lotion ingredient
   (c) Cake frosting ingredient
   (d) Chocolate syrup ingredient
2. What is unusual about the giant bladder kelp?
   It may be as tall as a six-story building. It is one of the world's most rapidly growing plants.
3. Why wouldn't you find kelp near Florida?
   It grows in cold water.
4. How would you recognize a sea palm?
   It looks like a miniature palm tree.
5. Name two means of support for sea plants.
   (a) Bladders filled with air
   (b) The water
6. What are ways that seaweeds help sea animals?
   (a) Provide food
   (b) Protection and oxygen
7. What are three parts of seaweeds?
   (a) Holdfast
   (b) Stipe
   (c) Blade
8. What dangers are seaweeds facing?
   Pollution from oil wells.
9. Complete these sentences:

Holdfast	is the part of the kelp that secures (attaches) the plant to rocks, etc.
Blade	is the leaf-like part of seaweeds.
Bladders	are sacks filled with gas which hold up the plant.
Oil Wells	are leaking pollution into the sea and seaweed is being affected.
Predators	are animals that swim around through seaweed looking for other animals to eat.
Stipe	is the "trunk" of seaweeds.

Adapted from *Wet and Wild*

STARCH LIGHTLY

DESCRIPTION

Uncovered and foil-covered coleus leaves are tested for starch production.

OBJECTIVE

C-1. To understand how the energy radiated by the sun is used on earth to maintain ecological processes.

PURPOSE

To illustrate the role of light in the production of food (starch) by a green plant.

Time
Introduction: 20 minutes
Activity:
Two class periods of 45 minutes each

Where
Classroom

Topics
Food chains, human ecology, plants

Materials
These amounts are for a class of 30: several coleus plants, aluminum foil, 5 hot plates, 5 250 ml beakers containing 100 ml alcohol, 5 ml beakers of water, 5 dropper bottles of iodine (IKI) solution, cornstarch, powdered sugar

LEAD-UP/PREPARATION

Three days before the experiment is to begin, place several well-watered coleus plants in a taped cupboard to remove them completely from daylight. Buy or prepare IKI solution.

Q: Are there any foods we eat that cannot be traced back to green plants?

Q: Do we need plants in order to live?

ACTIVITY

One group of foods we eat contains starch. We can easily test for this with iodine.

Step 1
Remove plants from cupboard before class.

Step 2
Divide the class into research teams of six students each.

Step 3
Assign each group of six students a coleus plant.

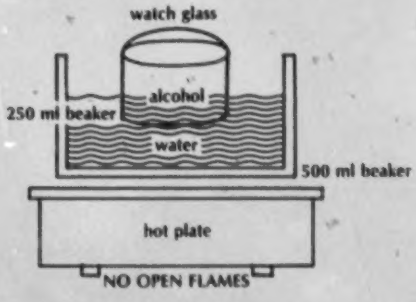
Step 4
Each team should cover one leaf of the plant with foil. Label its covered leaf with masking tape. Be careful not to damage the leaf.

Step 5
Leave the foil on the leaf for two or three days. Place plant in a well-lighted place. Water if needed.

Step 6
Remove covered leaf from plant. Remove foil.

Step 7
Place leaf in boiling water until limp (two to three seconds).

Step 8
Place leaf in hot alcohol until the leaf turns white (one to three minutes). *Alcohol is flammable!* Therefore, it is best to heat the alcohol in a hot water bath on a hot plate.



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A watch glass on top of the alcohol beaker will *keep the alcohol from evaporating when not in use.*

Step 9
Put the leaf back in boiling water until flexible (ten seconds).

Step 10
Put the leaf in container (petri dish bottom works well) and flood with iodine. A very few black spots indicating starch should appear.

Step 11
Repeat steps 1-9 with an uncovered leaf. It should appear nearly all black.

Step 12
Compare the covered and uncovered leaves.
Q: What is the difference between the covered and uncovered leaves?
Q: Why didn't the covered leaves have as much starch as the uncovered?
Q: What are plants able to do with sunlight that people or other animals are not able to do?
Q: What else besides food do plants provide?
Q: What would happen to life on this planet if all the plants were destroyed?

FOLLOW-UP

Test several different foods for starch. Note that plants contain starch.

SUN FUEL

DESCRIPTION

Students prepare and perform a role-play activity on energy transfer.

OBJECTIVE

C-2. To understand that energy can be stored by plants and converted through natural processes into large-scale energy sources such as petroleum, natural gas, and coal.

PURPOSE

To show that fossil fuels are stored sunlight.

Time	**Where**
30 minutes	Classroom or field
Topics	**Materials**
Fossil fuels, energy resources	None

LEAD-UP/PREPARATION

Discuss the following concepts with the students:
1. All energy comes from the sun.
2. Some of this energy has been stored as fossil fuels.
3. Fossil fuels are used today as energy sources for home heating, transportation, power generation, and also for producing synthetic materials like plastic, nylon, and fiberglass.

ACTIVITY

Step 1
Ask the students to close their eyes, be very quiet, and listen for any fossil fuel users (autos, airplanes). List these on the chalkboard. Now, ask the students to look carefully around them. What fossil fuel users are they able to see? (Synthetic carpeting, polyester clothes, plastic bags.) Continue the list on the chalkboard.

Step 2

Do a narrative role-play something like the example below:

"You've got a yellow sweater. Why don't you wrap it around your shoulders and stand up here? Now the yellow sweater wearer is the sun. And to show your energy, sun, flex your muscles. Good, strength from the sun.

"Now we need several students to be the land and water plants in need of a little of the sun's energy—limp tree ferns, and very tired algae. O.K. You, muscle energy sun, touch these plants lightly with your finger—full of energy, and go 'Zap!' Now ferns, show your new energy; stand with your biceps flexed (photosynthesis).

"O.K. Now who eats plants? In the sea, *zooplankton* and on land, insects. You two students be insects that get their life energy from ferns. And you two be sea-dwelling *zooplankton* that get their energy from algae. Now plants, touch them with your fingertips, as if the sun tapped you; give them your energy. Zap! Now insects and *zooplankton* flex your energized biceps."

Do the same energy zap with plankton-eating fish and insect- and fern-eating dinosaurs. Everyone gets muscles symbolizing energy transfers from the sun.

FOLLOW-UP

1. Have students write a report on the origin of oil.
2. Discuss: Oil is a limited resource because it takes so long to form and because the conditions under which it forms are so specialized. Which of the following are also limited energy sources?
    - Coal
    - Natural gas
    - Solar (direct, passive, or active)
    - Geothermal
    - Biomass
    - Nuclear fission
    - Nuclear fusion
3. Discuss each in terms of its safety, resulting pollution, cost, and efficiency

Adapted from *Manure to Meadow to Milkshake*

ENERGY AND POETRY

DESCRIPTION

Students read several personal statements on energy as a stimulus to expanding their own perspectives and writing their own poems.

OBJECTIVE

C-3. To understand that energy can neither be created nor destroyed. It is in a constant state of flux.

PURPOSE

To consider the importance of energy and its relationship to all that moves, warms, and enlightens us.

Time	**Where**
3 hours (can be done in 3 one-hour sessions)	Classroom
Topics	**Materials**
Energy, aesthetics, environmental values	Per student: a copy of poems

LEAD-UP/PREPARATION

Prepare copies of the poems below for distribution to the class.

ACTIVITY

Step 1

Use the poems below for discussion.

Q: What is the energy message in each poem?

Q: How is the awareness and background of the reader important in interpreting the energy message?

Find other poems or song lyrics that speak of energy.

continued

Step 2

Encourage students to try a short poem of their own. Set limits, for example:

- A specific topic, such as sun, energy users, conservation
- A certain number of words or syllables (as in haiku)
- A particular meter
- Or some word play (e.g., having the initial letter of each line spell out an energy term)

FOLLOW-UP

1. Ask students to illustrate one or more of the poems on the handout or one of their own. Specify media or provide several options you will accept.
2. Have a contest for writing a rhyming energy slogan. Let the class develop the rules, decide how to publish them, select judges, set deadlines, choose an appropriate prize, and invite the whole school to participate.

Adapted from IDEAS

SOMETIMES

Sometimes when a bird calls out
Or the wind barrels through the trees
Or a dog howls on a farm far away,
I stop and listen.

My soul turns back again:
A thousand forgotten years ago
The bird and the blowing wind
Were like me, they were my brothers.

My soul becomes a tree,
An animal and a cloud.
Transformed, it comes home a stranger
And questions me. How can I answer?

Hermann Hesse
translation copyrighted 1970 by Charles Guenther
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BURNING MY BRIDGES BEHIND ME

The sun comes into my morning apartment
like a flamenco dancer,
his heels making sharp edges on the flaming tulips,
bullets of winter light explode on my yellow cushions,
and the asparagus fern drips with green moisture, its
delicate tendrils
curling with each click of the sun's
castanets.

Alone
now,
with only the sun as my lover,
and he invisible, as if we lived somewhere
East of the . . . and West of the Moon.

The way I denote him
is by starting fires. I burn the toast
in my oven while daydreaming about a cardinal flying through
a winter tree. My paper towels of yellow or red
catch on fire while I stand blazing
in a yellow kimono
hardly aware of anything but love. . . .

Diane Wakoski, copyright 1976

MODERN ART

Chocolate night,
Chimneys fuming plumes of rolling smoke—
Every window is oily-painted,
Even fresh snow is early tainted
Like my last unrealized hope.

Doris A. Simonis, copyright 1979

TO LIGHT THOU SHALL RETURN

Open the window:
    let the out-light in.
Open the atom:
    let the in-light out.
From every direction
    energy spawns delight.
Life is the interruption of light.

Doris A. Simonis, copyright 1979

BUT THE WISE PERCEIVE THINGS ABOUT TO HAPPEN

> *For the gods perceive things in the future, ordinary people things in the present, but the wise perceive things about to happen.*
>
> Philostratos, *Life of Apollonios of Tyana*, viii, 7.

Ordinary mortals know what's happening now,
the gods know what the future holds
because they alone are totally enlightened
Wise men are aware of future things
just about to happen.
Sometimes during moments of intense study
their hearing's troubled: the hidden sound
of things approaching reaches them,
and they listen reverently, while in the street outside
the people hear nothing whatsoever.

C. P. Cavafy, 1915

Poetry is the ultimate ephemeralization,
doing more with less, making possible
a current between what we feel and what we know,
a high tension wire that has the potential
of carrying into the future
a residual of human energy,
the power of wisdom.

Doris A. Simonis, copyright 1979

NO MORE SECONDHAND GOD

The revolution has come—
set on fire from the top.
Let it burn swiftly.
Neither the branches, trunk, nor roots will be endangered;
only last year's leaves and
the parasite bearded moss and orchids
will not be there
when the next Spring brings fresh growth
and free standing flowers.
Here is God's purpose—
For God, to me it seems,
is a VERB—
not a noun,
proper or improper;
is ARTICULATION,
not the art, objective or subjective;
is LOVING,
not the abstraction "Love" commanded or entreated;
is knowledge dynamic,
not legislative code,
not proclamation law,
not academic dogma, nor ecclesiastic canon.
Yes, God is a verb,
the most active,
connoting the vast harmonic
reordering of the universe
from unleashed chaos of energy. . . .

R. Buckminster Fuller, copyright 1963

SNOW BLIND

Having seen the sun
Once and forever,
I remember rainbows
Pale as December.

Doris A. Simonis, copyright 1979

continued

NATURAL ENVIRONMENT

SUN

Under my elbow. In my elbow.
Under my bed. In my bed.
Under my foot. In my foot.
Under my eye. In my eye.
    Yes. Yes. I've found it
The lost key, key, key, key, key, key—
What bird sings that song
    Key, key
A bird made out of keys,
flying to unlock the sun. let out the heat.
flying to unlock the moon. and let out the milk.
flying to unravel the mountain.
and resting on a branch saying,
key, key.

Diane Wakoski, copyright 1968

IOWA WINTER SONG

Snow-pied fields of
white-blue, blue-white
hummocky drifts in violet shadows—
Snow and sky blow
white-blue, blue-white
rippled wash of down-thrown light—
Grass stalks, corn shocks, wendy willows
flout yellow, yellow, YELL-oh!
They shout their quiet lives.

Doris A. Simonis, copyright 1979

SUN POEM

My anger slides through the water.
Can
anyone
get
out of bed
in the morning
as secretly
as the sun
manages to rise
& (often) / not be seen?

Diane Wakoski, copyright 1973

THE ENERGY OF POETRY

The poem has a social effect of some kind whether or not the poet wills that it have. It has kinetic force, it sets in motion . . . elements in the reader that otherwise would be stagnant.

Denise Levertov

TERRESTRIAL HI-LO HUNT

DESCRIPTION

Students find the locations in an outdoor study site that are the warmest, coolest, brightest, darkest, windiest, calmest, flattest, and steepest.

OBJECTIVE

D-1. To understand the factors which determine the variety and abundance of life that can be supported within a geographic area.

PURPOSE

To investigate the extremes of environmental variables in a study site as preparation for understanding the relationships between living organisms and their environment.

Time	**Where**
1 hour for construction of materials	Classroom
1 hour for the hunt	Outdoor site
Topics	**Materials**
Ecological niche, weather, scientific methods	For the class: 1 overview map of site, 1 felt pen; For each team of two: 1 pencil, 2 Hi-Lo markers (a stick with 3″×5″ card marked Hi and one stick with 3″×5″ card marked Lo), 1 equipment card and listed materials (see below), 1 action card (see below)

LEAD-UP/PREPARATION

1. Read the equipment cards and the instructions for the activity to determine the materials you will need for the environmental variables you have chosen to investigate.
2. Construction of the instruments for the hunt can be an activity in itself. If you have time, have the students prepare the instruments they will be using.

ACTIVITY

Step 1
Point out the boundaries of the study site to the group.

Step 2
Introduce the hunt. Tell the youngsters they are going Hi-Lo hunting. "Can you find the warmest and coolest, the brightest and darkest, the steepest and flattest, and the windiest and calmest spots in this site?"

Step 3
Divide the group into teams of two to four, and either designate or let each team choose the factor (light, wind, temperature, or slope) it will investigate. (If the group participated in the construction of the equipment, this decision has probably been made already.)

Step 4
Distribute two markers to each team for marking the spots where the highest and lowest measurements are taken. Each team should print the variable it is testing on the two cards.

Step 5
Hand each team the appropriate measuring device, Action Card, and a pencil. If the teams aren't already familiar with the Hi-Lo measuring devices, demonstrate each piece of equipment before handing it out.

Step 6
Let the hunt begin! Encourage the teams to take six or more measurements in each area in their hunt for Hi-Lo values.

Step 7
When all the teams have finished taking measurements and have set out their Hi-Lo markers, call the teams together and visit each of the Hi-Lo markers in the site. As the group moves from one marker to

continued

another, raise the following questions:

Q: What features of this spot might explain why this is the *darkest* (insert appropriate term) place in this site?

Q: Do any of the Hi-Lo measurements seem to relate to each other? For example, do the coolest spots also seem to be the darkest spots? Are the warmest spots also the brightest spots?

Q: Will the warmest and coolest spots in the study area always be the warmest and coolest? How about the other measurements?

Q: How might the direction of the wind cause some spots to be windy and others calm?

Q: How might the time of day change the Hi-Lo measurements? The time of year?

Q: Tell the group that physical factors, such as temperature, wind, light, and slope, that may change from minute to minute, day to day, or month to month are called *environmental variables*.

Q: In what ways do environmental variables affect humans and other organisms?

Q: In what ways do humans affect environmental variables?

FOLLOW-UP

1. For an interesting comparison, conduct the activity again at a different time of day, on another day, or during a different season.
2. Measure the changes which occur from early morning through late evening.
3. Select a site with different characteristics (ask the group to describe the differences) and compare the environmental variables of the two sites. If you have just studied a lawn, you might want to try a dense woody area, bare soil, pavement, or a meadow.

This activity is a modified version of the OBIS activity *Terrestrial Hi-Lo Hunt* that was developed at the Lawrence Hall of Science, U.C. Berkeley.

Action Card
TERRESTRIAL HI-LO

Temperature. Use a thermometer to find the warmest and coolest spots in this site.

Temp. C	Location
1.	
2.	
3.	
4.	
5.	
6.	

After you have finished taking temperature measurements, mark the warmest and coolest spots with your Hi-Lo markers.

Action Card
TERRESTRIAL HI-LO

Slope. Use a slope-measuring device to find the steepest and flattest spots in this site.

Slope (cm/meter)	Location
1	
2	
3	
4	
5	
6	

After you have finished taking slope measurements, mark the steepest and flattest spots with your Hi-Lo markers.

Action Card
TERRESTRIAL HI-LO

Wind. Use your wind station to find the windiest and calmest spots in this site.

Wind Speed (rev/min)	Location
1.	
2.	
3.	
4.	
5.	
6.	

After you have finished taking wind measurements, mark the windiest and calmest spots with your Hi-Lo markers.

Action Card
TERRESTRIAL HI-LO

Light. Use a light-measuring station to find the brightest and darkest spots in this site. (Remember: the darker the proof paper the brighter the spot.) Write the location of each exposure above each piece of proof paper.

After you have finished taking light measurements, mark the brightest and darkest spots with your Hi-Lo markers.

Equipment Card

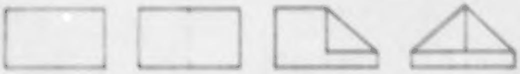
MEASURING WIND DIRECTION AND SPEED

MATERIALS FOR ONE WIND STATION:

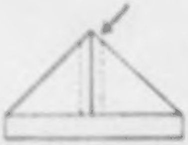
2 nails (16 penny)
1 or 2 cardboard bases (three thicknesses of cardboard glued together, at least 10 cm. by 10 cm.)
2 pieces of plastic soda straw (6 cm. long)
1 piece of heavy duty aluminum foil (15 cm. by 2 cm.)
1 roll scotch tape
1 magnetic compass
1 pair of scissors
1 marking pen
1 tube of glue
1 watch with second hand
4 3" x 5" index cards
1 stapler
1 square of cardboard (6 cm. by 6 cm.)

CONSTRUCTION OF WIND SPEED MEASURER

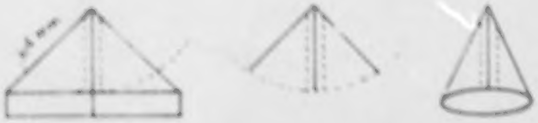
1. Make 4 cones as follows:
   Take a 3" x 5" card and fold it like this:



Tape it here with scotch tape:

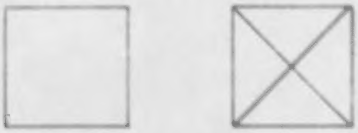


Cut on a curve like this:

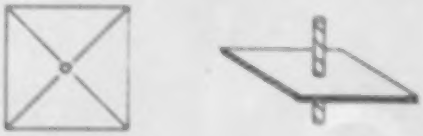


Open the cone, and make three more.

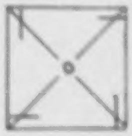
2. Construct your cone holder as follows:
   Cut 6 cm. cardboard square and draw two diagonal lines.



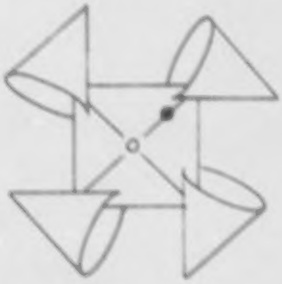
Where the two diagonals intersect, poke a hole with your nail and enlarge it until your straw segment fits snugly in the hole.



Cut four slots in the cone holder like this (cut in 1-2 centimeters):



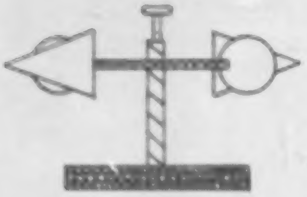
3. Assemble the apparatus:
   Slide a cone into each slot. Be sure they all face the same direction (clockwise or counterclockwise).



Put a reference mark on the cone holder near one of the cones to help you count revolutions.

Make your base by gluing three thicknesses of cardboard together.

Run a nail through the straw and stab it into the cardboard base.

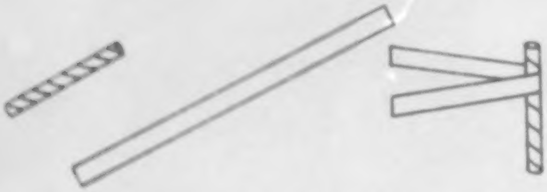


You may want to put a small washer here if you have one.

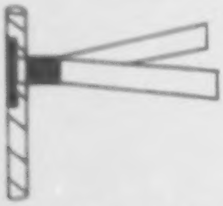
CONSTRUCTION OF WIND VANE

(for measuring wind direction)

1. Cut a piece of heavy-duty aluminum foil 15 cm. by 2 cm. Bend this around the second 6 cm. piece of straw.

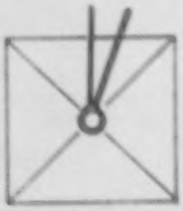


2. Fold the pieces of aluminum foil tightly together and tape them near the straw.

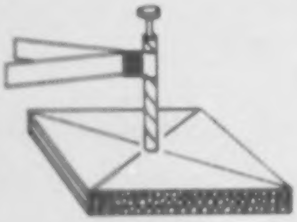


Slap a little piece of tape here to keep the aluminum foil from sliding up and down the straw.

3. Put a nail (small enough to allow the straw to rotate) through the straw and push it into a cardboard base (same as the wind speed measurer or a different base). Spread the two pieces of aluminum foil slightly, and you are ready.



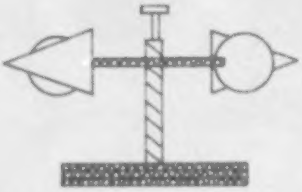
top view

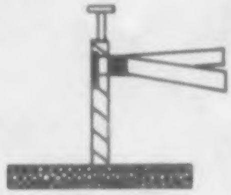


side view

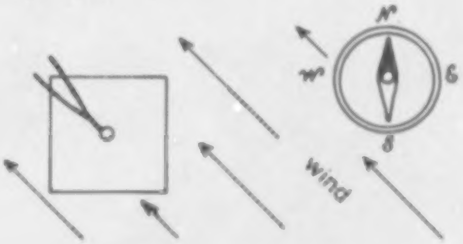
USING YOUR WIND STATION

With these two pieces of equipment you can measure direction and speed of wind.





Wind direction is measured with your wind vane. Place it in the wind and note the direction the aluminum foil swings. Winds are named for the direction they come *from*. A wind blowing *from* the north is a north wind. You will want to use a compass if you have one to help you determine directions. This is a south-east wind:



Wind speed is determined using an anemometer (the gadget with the four paper cones). The faster the wind blows, the faster the device turns. Wind speeds should be reported in revolutions per minute. (You will need a watch with a sweep second hand.) Set the wind speed meter in the location that you want to measure wind speed, get the watch ready, and holler "Go!"). One person watches the second hand while the other counts how many times the colored cone goes by. After a minute (or fraction of a minute), the clock watcher hollers "Stop!" and the other reports how many times the colored cone went by. Wind speed in a calm area might be 6 or 7 revolutions per minute (rpm) while fast wind might be in excess of 100 rpm's.

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Equipment Card

Measuring Slope

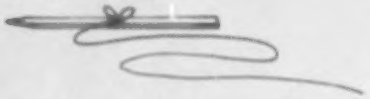
Outdoor Biology Instructional Strategies

MATERIALS FOR SLOPE-MEASURING DEVICE

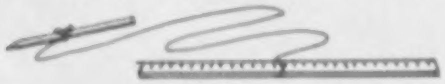
1 meter stick
1 125 cm. piece of strong cord
1 25 cm. sharpened stick
1 level tube (test tube and cork)*
household ammonia
water
tape

Slope can be determined by fixing an anchor point at the upper part of the slope, drawing the one meter cord taut, sliding it up or down until the cord is level, and reading slope directly in cm/meter. Assemble the apparatus like this:

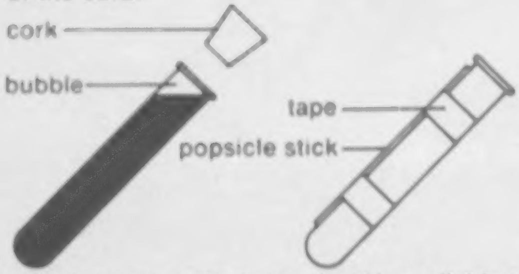
1. Sharpen the 25 cm. stick and fasten the cord to it with a knot which can slide up and down the stick.



2. Attach the free end of the cord to the meter stick so that the distance between the two sticks is one meter, and the cord can slide on the meter stick. You can mark off centimeters on any stick if you do not have a meter stick.

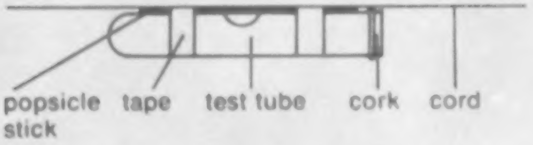


3. Make your level. Fill the test tube almost full of water and add a drop of ammonia. Cork the tube so that a small bubble remains. Trim off top of cork. If your test tube has a flared lip at the top, tape a popsicle stick to the side of the tube before taping the level tube to the center of the cord.

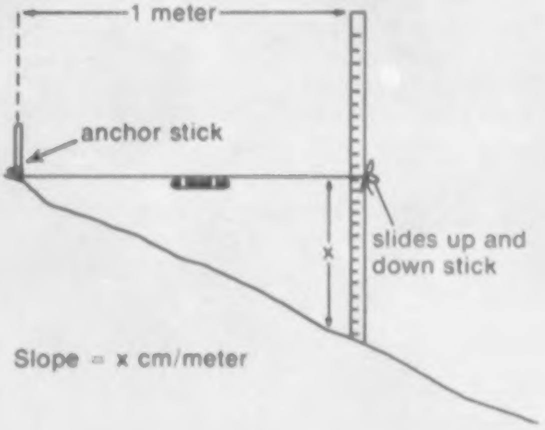


*A little bubble called a line level is available at hardware stores or may be purchased from the Lawrence Hall of Science. See the order form in the *OBIS Toolbox* folio.

Your level should look like this:



4. Assemble all pieces and use like this:



Slope = x cm/meter

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Equipment Card
Measuring Light

Outdoor Biology
Instructional Strategies

MATERIALS FOR LIGHT MEASURING STATION

1 package of proof paper (Studio Proof F, Kodak)
1 small jar of photographic hypo (fixing solution): mix 1 tablespoon of crystal for each cup of water.
1 small jar of plain water
1 pair of forceps or tweezers for transferring the pieces from the fixer into the water and onto the cardboard.
1 piece of cardboard (approximately 40 cm. square)
some pins or tapes
1 watch or kitchen timer

Note: Certain hard-to-get materials, such as the proof paper, are available from the Lawrence Hall of Science. See the order form in the *OBIS Toolbox* folio.

How to use OBIS Proof Paper Light Meter:

Print-out paper (Studio Proof F, Kodak) can be used to measure light intensity. A five minute exposure time will turn a piece of white proof paper dark brown when exposed to direct sunlight, light brown when exposed to filtered light (shade or overcast), and white to light tan when exposed to deep shade or artificial light. You can halt the color change by dipping the papers into photographic hypo (fixing solution) for a few seconds and then washing them in plain water for a few seconds. The fixed pieces can be dried by pinning them on a piece of cardboard.

A standard sheet of proof paper will suffice for 16 field exposures; simply cut the sheet into 16 pieces. Cut the sheets indoors and keep them in light-proof packages until you are ready to use them. To use proof paper, simply remove a piece, write the location of exposure on the back of the piece, expose it for five minutes, fix and wash it, and pin it up to dry. Proof paper is insensitive enough to allow for small time delays and exposure errors.

To use proof paper underwater, you will have to use a transparent, waterproof housing like a glass jar with a waxed lid, or several plastic bags placed one within the other and sealed with rubber bands. Attach the proof paper to a small piece of cardboard and weight the jar or bags so that the proof paper faces the surface when it's submerged.

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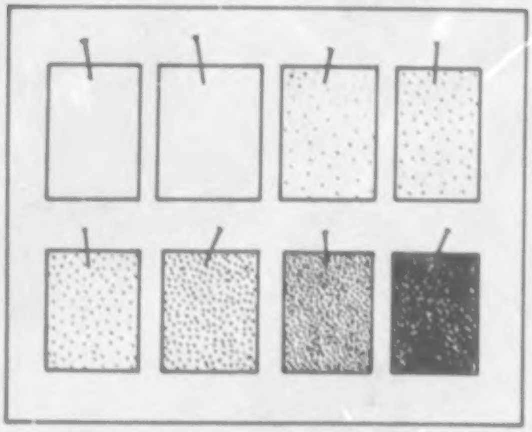
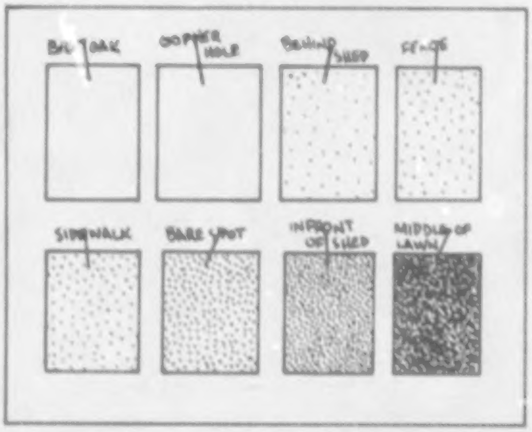
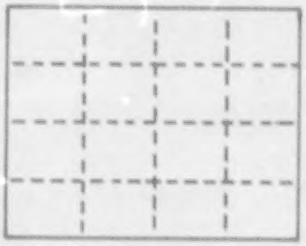
For *Water Holes to Mini-Ponds*



For *Terrestrial Hi-Lo Hunt*



Write the location of the exposure above each piece of paper after pinning it on the drying board.



HYPOTHETICAL ORGANISM

DESCRIPTION

Students design animals or plants and explain the reasons for the organism's survival or extinction.

OBJECTIVE

D-2. To understand how the biological community of plants, animals, and microorganisms adapt to the environment through changes in genetic composition and population size.

PURPOSE

To demonstrate the various factors that contribute to the endangering or extinction of a species.

Time 45 minutes for introduction 1-2 class periods for follow-up/sharing	**Where** Classroom
Topics Wildlife, plants, ecological balance	**Materials** Various materials for at-home construction of a model—for each group of three: an adaptation card (see below), color-illustrated book on insects (optional)

LEAD-UP/PREPARATION

1. Give each group of three students one adaptation card (see examples below). Give the groups five to ten minutes to list behavioral or physical characteristics of plants and animals which seem to fit the adaptation category on the assigned card.
   Adaptations to cold climates:
      - Adaptations to hot dry climates
      - Adaptations to windy places
      - Adaptations to grassy plains
      - Adaptations to thickly forested jungles

   Adaptations for defense:
      - Adaptations for communicating with other members of the species
      - Adaptations for warning other species to stay away
      - Adaptations for catching prey
      - Adaptations for protecting young
2. Have each group share its lists with the class.
3. (Optional) Discuss the role of color and form adaptation in insects as examples of mimicry, warning, and camouflage, using pictures from a well-illustrated book on insects.

ACTIVITY

Step 1

Ask each student to design a hypothetical animal or plant. The organism may have lived in the past or be alive today. In either case, the student should consider the following in his/her design:

Q: Where did (does) the organism live?
Q: How did (does) the organism get the energy it needs for survival?
Q: How did (does) it protect itself from predators?
Q: How did (does) it reproduce?
Q: If it is extinct, what were the causes of its demise; if it is still living, what adaptations have enabled it to survive?

Step 2

Direct each student to construct a three dimensional model of his/her plant or animal and its habitat. The models can be constructed of any material but must be accurate not only in form but also in color. Baker's clay or papier-mâché are useful materials.

Step 3

Allow each student three minutes to present his/her organism to the class explaining its specific adaptations. Follow the presentation with two minutes of questioning from the class.

FOLLOW-UP

Put all the hypothetical plants and animals on display with a brief explanation of the organism on a numbered 3" × 5" card. Have a contest, with the students voting on the most original, best defense mechanism, best camouflage, etc. Tally students' votes and give an award in each category.

CHARLIE CARBON MONOXIDE AND HIS CO-CONSPIRATORS

DESCRIPTION

Students set up indicators for carbon monoxide and ozone in several outside locations and compare the effects with a control list in the classroom.

OBJECTIVE

D-3. To understand how humans manipulate the environment and cause changes in the balance of conditions.

PURPOSE

To point out some of the unseen by-products of our everyday activities and demonstrate the effects of these substances.

Time Three to four 45-minute periods at one-week intervals	**Where** Classroom and several outside sampling locations
Topics Air pollution	**Materials** Per team of two/Activity A: 1 coffee can, 1 rubber band, 1 lead washer. Per team of two/Activity B: 1 coffee can, one 2" × 2" slide frame, one 3" × 3" piece of nylon stocking.

LEAD-UP/PREPARATION

Students should be familiar with the sources of the following photochemical pollutants; carbon monoxide (CO), sulfur dioxide (SO$_2$), and ozone (O$_3$).

continued

Activity A: Investigating ozone

Step 1
Construct ozone detectors, as illustrated. You can eliminate the metal can shelter but it protects the rubber band from sun, rain, and wind. Make certain rubber bands are all alike (equal width, length, and thickness).

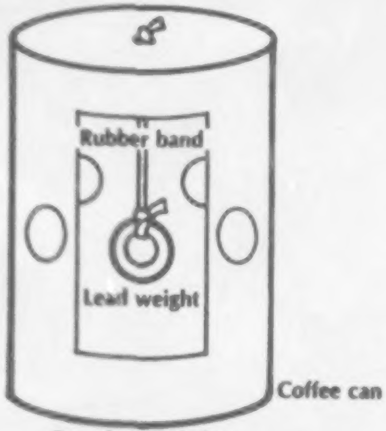
Step 2
Choose several locations around the school or community and place the ozone collectors at these locations.

Step 3
Check the rubber band every other day to observe and record any changes which occur in its appearance. Bring it back to the classroom after two weeks or if it breaks.

Step 4
Examine the condition of the band under the microscope.

Step 5
Mark off some 0.5 cm sections on the band. Stretch it lightly. Count the number of cracks in a 0.5 cm section.

Step 6
Compare bands from all locations.



Experiment Shelter

Activity B: Investigating sulfur

Step 1
Construct several SO_2 indicators by attaching clean nylon stocking material inside a 2" × 2" slide photograph frame. Replace the photo with the stocking material. To increase accuracy of results, hang each frame in a shelter, as illustrated in Activity A.

Step 2
Check each frame under a lens to be certain all nylons are alike (not frayed).

Step 3
Place one detector in the classroom (control) and three or four at each chosen location throughout the school and/or community.

Step 4
After one week, bring in one sample from each location and compare them with the control using a microscope or hand lens. Compare findings.

Step 5
After each succeeding week, bring in one sample from each location. Find out what is happening at different locations over a longer period of time.

FOLLOW-UP

Identify all the items you can think of which may be attacked by ozone or sulfur dioxide.

Adapted from *Green Box*

GEOSTRUCTURES

DESCRIPTION

Students construct a model of geological evolution—a before and after demonstration.

OBJECTIVE

D-4. To understand the natural forces that continually shape the environment.

PURPOSE

To illustrate the process of natural change on the face of the earth.

Time
Activity: 20 minutes for introduction
Total time: 2 45-minute periods for sharing models with class

Where
Classroom

Topics
Geology, natural disasters

Materials
Students provide materials for model buildings from home

LEAD-UP/PREPARATION

Discuss the changing of the earth's surface.

ACTIVITY

Step 1

Q: The surface of the earth is constantly changing. What are some of the natural causes of these changes?

volcanoes
glaciers
earthquakes
water erosion
wind erosion
island formation
tectonic plates moving
rivers
wave action
sedimentation
mountain building

Ask each student to select a geological change s/he would like to investigate. S/he may choose either a type of change like river aging or a specific geological formation like Half Dome in Yosemite or the Pinnacles. In either case, s/he is responsible for constructing a model which will show the land in two stages of its evolution.

Step 2

Brainstorm possible construction methods.

- Baker's clay or modeling clay
- Canned styrofoam from packing crates
- Papier-mâché
- Ceramic clay, etc.

On the day the models are due, give each student a 3"×5" card. Instruct the students to write the name of their project and a brief description of it on one side of the card. Place the cards on the projects.

Step 3

Give each student three minutes to explain the process s/he has illustrated. Allow one minute for questions from the class.

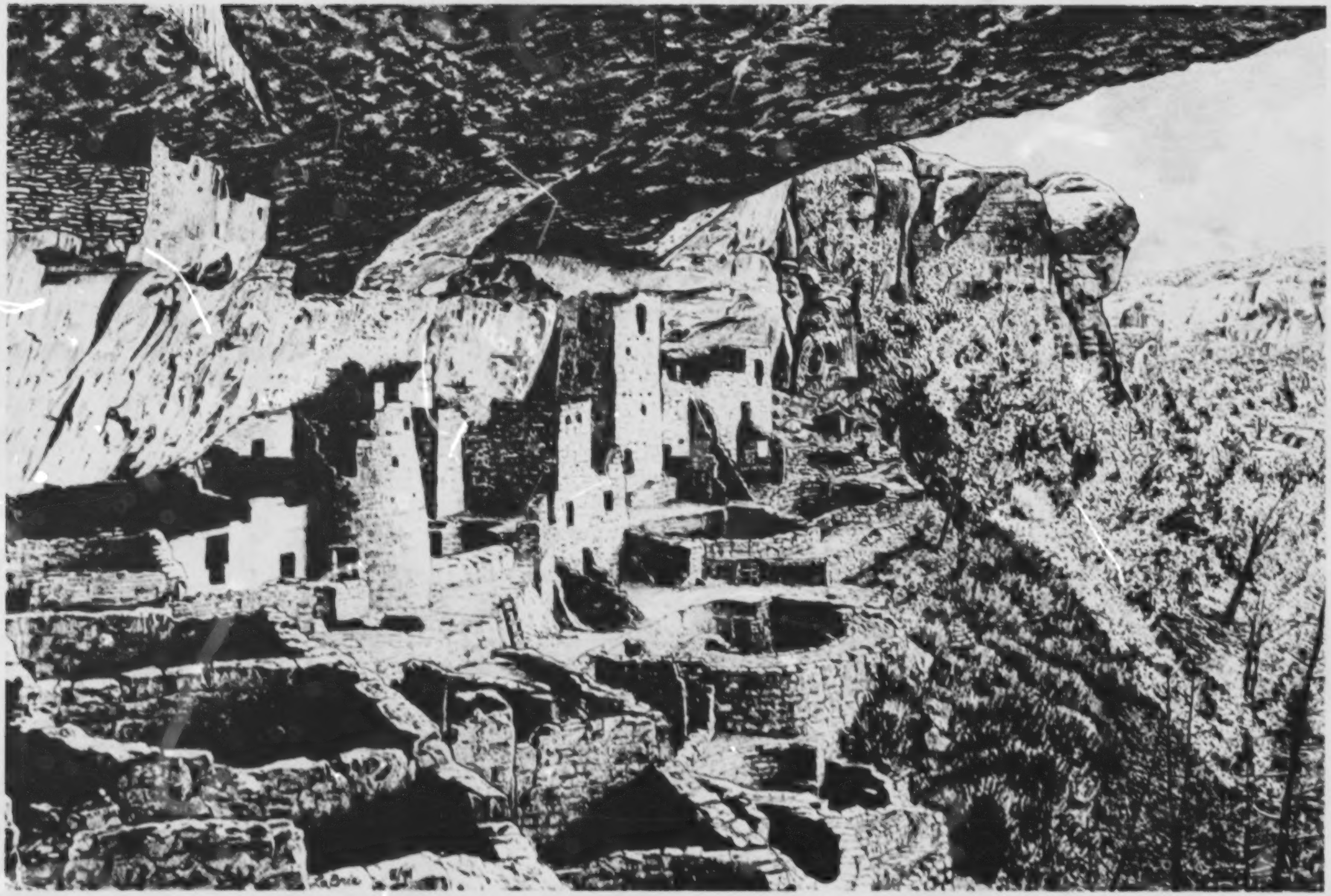
FOLLOW-UP

1. Arrange for students who wish to exolain their projects to classes in the elementary schools.
2. Display models in library.

TROUBLE-SHOOTING

Many students will want to do their projects on volcanoes and earthquakes. A sign-up list on the board is probably the best method of assuring variety and settling disputes.

Built Environment Activities



BUILT ENVIRONMENT

Issues

Built Environments or human communities have evolved out of the natural environment over the past two to three million years. As innately social animals, we humans have consistently engaged in group efforts to satisfy our basic needs. Our communities stand as dynamic evidence of our efforts thus far. Human communities share many characteristics with other living systems, such as the need for nutrients, energy, food, materials for shelter, and waste disposal. Our techniques for satisfying needs and desires, however, have had much wider impact than those of any other organism. We have reached out over greater areas to gather the resources to support our lifestyles and we have deposited our wastes on the land and in the air and water.

As Built Environments continue to evolve, the quality of life for their inhabitants has improved in some respects and declined in others. We can cite astounding technological advances in areas such as health care, communications, transportation, and the production of goods. Yet, these advances have brought concomitant dilemmas. For example, advances in health care have resulted in the obliteration of many diseases and the prolongation of human lives. However, this has caused increased population growth which, in turn, has resulted in increased competition for natural resources. Advances in communications technology has made it possible to retrieve information from any part of the globe within seconds. Yet, it also contributes to a loss of control, as methods for processing information become more centralized and our individual "data banks" become overloaded. Industrialized countries have advanced exploration and transportation technologies to the point where we have access to natural resources throughout the world. Yet, the distribution of these resources is grossly unequal with 33 percent of the world's population consuming 80 percent of the available resources. Finally, advances in the production of goods have resulted in wider choices, lower prices, and an improved quality of goods for the consumer. Unfortunately, the quality of the work place has suffered as workers often find their highly automated jobs dull and meaningless.

These are merely a few of the technological advances and concomitant problems that have accompanied the evolution of the Built Environment. As we strive to build healthier communities, we must consider the central area of human environments: the cities. They serve as the hub of social, political, and economic activity. As cities grow in size and complexity, they generally become less desirable places to live. Currently, we see evidence of an increased dissatisfaction with city life as more and more people move to the urban fringe. Fortunately, we can also see evidence of efforts to revitalize the city by improving housing and public transportation and reestablishing a sense of community. As we strive to improve the Built Environment, perhaps we should begin by improving the quality of life within our cities.

Three concepts have been defined for enhancing student understanding of the Built Environment. The first considers the dependency of the Built Environment on the Natural Environment. The second considers the evolution of the Built Environment and the influence of societal values on that process. The third stresses a perspective that views the Built and Natural Environments as intertwined through an intimate cause/effect relationship.

BUILT ENVIRONMENT

MAJOR CONCEPTS	OBJECTIVES
A. Built environments depend on resources from the natural environment for survival.	1. To understand that built environments require continuous supplies of energy and resources from the natural environment. 2. To understand how humans manipulate and cultivate the natural environment to ensure consistent and continuous supplies of resources for built environments. 3. To understand how technology expands the geographic area from which built environments draw on resources from the natural environment.
B. The design and maintenance of built environments have both reflected and influenced the values, ethics, and lifestyles of the inhabitants.	1. To understand how geographic location, available space, people's needs for services, human contacts, and aesthetic stimulation interact in determining the design of a built environment. 2. To understand how technological development and industrial expansion have contributed to the development of the modern day megalopolis in all parts of the world. 3. To understand how individual and societal values and ethics influence the design of different types of built environments.
C. Built and natural environments function in similar ways and share many basic needs for survival and growth.	1. To understand that continuing supplies of energy are essential for the maintenance of life in both natural and built environments. 2. To understand how both built and natural environments are dependent on the continuous renewal of resources. 3. To understand that built and natural environments are continuously interactive, and changes in one area of the environment can cause changes in many other areas.

BUILT ENVIRONMENT OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand that built environments require continuous supplies of energy and resources from the natural environment.	Students examine natural structures and build some of their own.	Students analyze a collection of items to discover what resources were used to manufacture them.	Students design and keep an energy log for one day.	In a game, students identify the materials and energy consuming processes which went into the building of the school plant.
	2. To understand how humans manipulate and cultivate the natural environment to ensure consistent and continuous supplies of resources for built environments.	Students express appreciation for natural resources contributing to their lives.	Students look "beyond" the supermarket shelves at the relationship between the land and food.	Students interview older persons to learn of the sources of resources in the past.	Students design a park for their community.
	3. To understand how technology expands the geographic area from which built environments draw on resources from the natural environment.	Small groups create a mural or mobile showing the origin of the component parts of common items.	Students find out **everything** they can about chalk: its origin, uses, manufacture, history, etymology.	Students read two river poems and write some of their own. The river is fragile, a metaphor for our own flow.	Students exchange "environmental materials" with another class in a different region.
CONCEPT B	1. To understand how geographic location, available space, and people's needs for services, human contacts, and aesthetic stimulation interact in determining the design of a built environment.	Students experience different "population densities" in the classroom and discuss the effects of each situation.	Students design a small town in which they would like to live, and then must resolve the problem of increasing population.	Students shop for "wants" in stores of their own design.	Through word manipulation and other arts media, students share perceptions of societies' successes and/or failures in meeting personal needs.
	2. To understand how technological development and industrial expansion have contributed to the development of the modern day megalopolises in all parts of the world.	Students draw a picture of a dwelling used in a primitive society and a dwelling from the neighborhood. They list the differences in the dwellings.	Students inventory all of the materials and energy sources needed to play baseball.	Students draw lines between environmental concepts to show interconnections.	Class takes a field trip to a local secondhand store and compares goods of different vintages.
	3. To understand how individual and societal values and ethics influence the design of different types of built environments.	Students discuss and try out ways of physically arranging the classroom.	Students inventory and evaluate the energy-using aids and appliances in their homes.	Eating pretzels as fuel, students investigate transportation alternatives through a game.	Students run an extended role-play based on a Federal Court hearing on land use.
CONCEPT C	1. To understand that continuing supplies of energy are essential for the maintenance of life in both natural and built environments.	Students do physical exercises, observe and build simple machines, and discuss energy needs for various tasks and occupations.	Students perform an experiment with yeast to show that biological functions require energy and that the system loses heat.	Students assess all of the energy that goes into a garden. Several types of gardens are detailed.	Students analyze an oil company's "energy time line" which makes predictions for the future.
	2. To understand how both built and natural environments are dependent on the continuous renewal of resources.	Students examine changes in water, air, and the sun's movement on the school grounds.	Students draw pictures of their dwellings if environmental factors (space, climate, etc.) were changed.	Students assess the artist's values through analysis of landscape painting.	Students outline the environmental implications of the freedom to live wherever they desire.
	3. To understand that built and natural environments are continuously interactive and changes in one area of the environment can cause changes in many other areas.	Students list all of the things a plant needs for survival and then extend these factors to their own cases.	Students examine the differences which exist on different sides of a building with respect to the plant life and other environmental factors.	Students examine human uses of snow in various regions.	Students generate a list of possible environmental happenings and then list the consequences of those.

ENERGY LOG

DESCRIPTION

Students design and keep an energy log for one day.

OBJECTIVE

A-1. To understand that built environments require continuous supplies of energy and resources from the natural environment.

PURPOSE

To sensitize students to the amounts and types of energy used daily in our lives.

Time 2 one-hour periods, some homework for Part I and Part II	**Where** Classroom
Topics Energy, transportation	**Materials** Energy log worksheet; city transportation worksheet

LEAD-UP/PREPARATION

Duplicate copies of the sample energy log and the city transportation log below.

Activity 1

Step 1

Distribute the sample energy log. Discuss ways of modifying the log to improve its usability by the students; i.e., they might want to focus on one kind of energy for each log.

Step 2

Duplicate and distribute the modified log to all students. Be sure everyone understands how to fill in the log. A good time period to keep the log is from just after school one afternoon until just before school the next day. Be sure to discuss the different kinds of energy they should watch for, such as electrical appliances, gasoline for transportation, heating, cooling, recreation, etc.

Step 3

The next day, have your students share their logs with each other. Did anyone miss a particular item of energy use? What were the similarities between students' usage of energy? The differences? Were some usages more intensive? Finally ask students if they can identify where energy was wasted or where it could be saved.

SAMPLE ENERGY LOG

Name ____________________ Date ____________________

Amount of energy used	Activity	Kind of energy	Purpose	Comments

Activity 2

Step 1
Distribute copies of the city transportation worksheet to each student. Divide students into teams of four or five. Ask each team to select a corner or busy intersection as its observation point. For 30 minutes during a busy time of day, the team should observe the traffic, recording passing vehicles by size, type, etc.

City Transportation
Date: ____________
Time: ____________
Team members: ________________________________

Vehicle	Number of Riders					
	1	2	3	4	5	More
Large Car						
Small Car						
Bus						
Taxi						
Large Truck						
Small Truck						
Bicycle						

Step 2
When the students return with their surveys, ask them to compute the ratio of large cars to small cars and the ratio of cars to other types of transportation. Which cars carried the most passengers? If a small car uses one-third less gasoline but only carries one-half the number of people as a large car, which car is more efficient?

FOLLOW-UP

Keep an energy log for a longer period of time.

RESOURCE INTERVIEW

DESCRIPTION

Students interview grandparents or other older citizens to learn the sources and uses of natural resources in the past.

OBJECTIVE

A-2. To understand how humans manipulate and cultivate the natural environment to ensure consistent and continuous supplies of resources for built environments.

PURPOSE

To understand the changes in our use of natural resources during the last 40-50 years.

Time 2-3 one-hour periods	**Where** Classroom
Topics Resource management, technology, cultural history	**Materials** Grandparents and other older citizens willing to be interviewed

LEAD-UP/PREPARATION

Duplicate "sample interview" as an aid to generating questions.

continued

ACTIVITY

Step 1

Introduce the interview with grandparents or other older citizens as a way of finding out how our uses of natural resources have changed in the last 40-50 years.

Step 2

As a class or in teams, have your students develop a questionnaire emphasizing the sources and uses of natural resources.

Step 3

Ask your students who they would interview. Send invitations and a questionnaire to interested older individuals to let them know in advance of the goals of the interview.

Step 4

Conduct the interview in your classroom. If this is not possible, have teams of students visit the older person at her/his home and conduct the interview. For comparison, interview a student.

Step 5

Share and discuss the interview results. What are the changes in food, light, transportation, cooking, recreation, heating, etc? What might have caused the changes? Can we decide if they were good or bad?

FOLLOW-UP

Have students imagine that they are older persons being interviewed 60 years from now. How will energy sources and uses be different then?

THE NEW RIVER

DESCRIPTION

Students read two river poems and write some of their own. The river is fragile. The river is a metaphor for our own flow through the environment.

OBJECTIVE

A-3. To understand how technology expands the geographic area from which built environments can draw on resources from the natural environment.

PURPOSE

Our technology draws on the natural environment for its sustenance. The natural environment is limited and fragile.

Time 1 hour	**Where** Classroom
Topics Rivers, aesthetics, pollution	**Materials** Copies of poems below

LEAD-UP/PREPARATION

Prepare copies of "The New River" by Charles Ives and "Out in the Country" by the Three Dog Night for your class.

ACTIVITY

Step 1

Read the two poems to your class.

The New River by Charles Ives

Down the River comes a noise!
It is not the voice of rolling waters.
It's only the sounds of man,
phonographs and gasoline,
dancing halls and tambourines;
Killed is the blare
of the hunting horn;
The River Gods are gone.

Out in the Country recorded by Three Dog Night

Before the breathing air is gone,
Before the sun is just a bright spot
in the nighttime,
Out where the rivers like to run,
I stand alone, and bring back
Something worth remembering.

Step 2

Ask your students for their reactions to these poems.

Q: Which one do you like best? They are both depressing poems inasmuch as they both paint dismal environmental pictures.

Q: Which one is the more hopeful of the two? "The New River" was written in the late sixties and was a very popular top 40 hit.

Q: What has changed since then?

Q: Are there many environmentally focused songs on the charts today?

Q: Why not?

Q: Is it because conditions have changed, improved since the late sixties, or is there some other reason?

Step 3

Ask for poems on a local river or stream. Ask your students to use an idea, such as "I am the river" or "I am like a river," when writing their poems.

FOLLOW-UP

Find out about Charles Ives. Get some recordings of his fascinating songs. Find out about Pete Seeger's work on the Hudson River. Dams do things to rivers. Do a project on the pros and cons of a local dam.

THE GENERAL STORE

DESCRIPTION

The students make a list of items found in the outdoor environment. Next, they make up "want lists"; anything they would like to have, and put these items in four "stores" in the classroom. Students then "shop" for items and compare the impact of selected consumer goods on the outdoor environment.

OBJECTIVE

B-1. To understand how geographic location, available space, and people's needs for services, human contacts, and aesthetic stimulation interact in determining the design of a built environment.

PURPOSE

Students will list perceived values of outdoor environments, consider the relationship between perceived outdoor values and consumer behavior, and inspect how contemporary outdoor recreation activities might affect the values held for the outdoors.

Time 1st day—30 min. 2nd day—30 min. 3rd day—2 hours	**Where** Classroom
Topics Human ecology, urban environment, population control	**Materials** Paper and pencil, "shopping lists"

LEAD-UP/PREPARATION

Have the students discuss the things they like about the outdoor environment. They should *not* list things they like to *do* outdoors. (See Step 1) This distinction is very important to the activity. The most powerful part of this lesson is the realization of the conflict between what we value in the environment, and the impact of what we do in the environment.

continued

ACTIVITY

Step 1

On the first day, give the students about 20 minutes to make a list of things they like about the outdoor environment. Remember, they should *not* include things they like to *do*. Lists should include such entries as I like the feel of the sun; I like the sound of birds in the trees; I like wood products, etc. Have them place their names and the date on lists and collect the lists.

Step 2

On the second day, take 20 minutes to make a "wants list" as a class. The students should suggest items they would like to have and use in the outdoor environment. Add some wants of your own. Ask them to think of outdoor items for all seasons of the year. The completed list will be the students' "shopping list." (See Step 3 for examples.)

Step 3

Divide the list into several categories of goods: sporting goods, transportation vehicles, electronics, clothes, general store (those that don't fit other categories). Give each item a price (portable stereo—$65, 10-speed bike—$180, tennis racket—$55, etc.). These price lists will make up the stock lists for each of the several "stores" you will have operating during the third activity session.

Step 4

Distribute a shopping list to each student (list of *all* items). Choose two students to set up a store selling the above items.

Step 5

When stores are ready for business, let the rest of the class visit the store and "buy" things they want. Each student has $1,000 to spend—no more.

Step 6

When everyone has finished their shopping, have them exchange lists and double-check that the $1,000 limit was not exceeded.

Step 7

Make aconsumer product survey. Call out the items on the shopping list one at a time. Students who purchased that item should raise their hands. Everyone then writes how many students bought that item next to that item on *his/her* shopping list. From this, the students can get an idea of the most popular items, and compare their own choices to the class trend. Make a list of the ten items most frequently purchased by the class.

Step 8

Discuss some of these questions:

Q: Which of the ten favorite class items use energy? How many do not? How many students have a few energy consuming items on their lists?

Q: Which of the ten favorites are disruptive of nature (cause air, water, or noise pollution; cause erosion or plant or animal destruction, etc.)?

Q: Are any of the ten favorites biodegradable? How can they be disposed of when they are no longer useful?

Q: Where would you place the lifestyle of the class on this scale? Explain.

Little disruption of Nature ——→ Much disruption of Nature

Step 9

Pass back the lists of outdoor environmental values prepared in Step 1. Have the students think about how the items they chose to buy fit in with what they like about the outdoor environment. Have them write a paragraph or two about what they like about the outdoors, what they like to do outdoors, and how what they do might affect what others like about the outdoors.

FOLLOW-UP

1. Have students select one or two items from their list of purchases and make a list of the raw materials that go into the manufacture of the items. How does the process of getting those materials, processing them, and manufacturing the item fit in with your values for the outdoor environment?
2. Prepare an interview form and interview managers of real stores of the type you simulated in class. Find out what items are selling best and compare your class "want list" to real trends in your community.

Adapted from *Environmental Education Activities Manual*

INTERCONNECTIONS

DESCRIPTION

Students draw lines between environmental concepts to show interconnections.

OBJECTIVE

B-2. To understand how technological development and industrial expansion have contributed to the development of the modern day megalopolises in all parts of the world.

PURPOSE

To emphasize the interdependence between energy and environmental concerns and the potential for "good" or "bad" effects.

Time
1 class period

Where
Classroom

Topics
Interdependence, environmental values, recreation, wildlife

Materials
Worksheet

LEAD-UP/PREPARATION

Duplicate the interconnections worksheet below for each student.

INTERCONNECTIONS

Note: More than one arrow may be drawn to any of the items. Arrows may go from A to B or from B to A.

COLUMN A	*COLUMN B*
More Pollution	More Deaf People
More Buildings	More Dirty Air
More Hunters Coming Back	Less Water
More Deaths	Less Gas
More Noise	Fewer Hunters
More Factories	More Hearing Aids
More Cars	More Droughts
More People	More Time for Animals to Grow
Fewer Animals	Fewer Trees
Good Change	Bad Change
Bad Change	Good Change
	Better Recreation

ACTIVITY

Step 1

Distribute a copy of "interconnections" to each student. Challenge the students to draw arrows connecting items in each column that the students feel would affect each other.

Step 2

Ask a student volunteer to hold up his/her diagram and explain how s/he came up with the arrows.

Step 3

Discuss different opinions among the class.

FOLLOW-UP

Ask a student to choose another identity; i.e., businessperson, environmentalist, Third World person, and speculate on how s/he might fill out the interconnections sheet. Share each "different person's" ideas.

THE FUEL GAME

DESCRIPTION

Eating pretzels as fuel, students investigate transportation alternatives through a game.

OBJECTIVE

B-3. To understand how individual and societal values and ethics influence the design of different types of built environments.

PURPOSE

To recognize the energy efficiency of different kinds of transportation.

Time About 1 hour	**Where** Outside your classroom
Topics Transportation, energy resources, resource planning	**Materials** 2 large bags of pretzel sticks per class, 3 paper signs, masking tape; copy the MPG sheet and cut up cards: 1 card per student

LEAD-UP/PREPARATION

Make three signs: Home, Near Town, Far Town.
Tape them to poles or walls outside in the following pattern:

Home ← 100 steps ← Near Town → 200 steps → Far Town
← 300 steps →

Review the general rules for your *own* information. Players should not know the number of steps.

ACTIVITY

Step 1

Play the game with at least six students.
Shuffle the MPG cards and let each student draw a card for him or herself. Distribute ten pretzels to each student, six for gas, four for his/her own food. No eating pretzels yet.

Volkswagen Rabbit 29 MPG - Carries 4 (29 steps per pretzel)	Chevy Luv Pickup 25 MPG - Carries 2 (25 steps per pretzel)	Porsche 17 MPG - Carries 2 (17 steps per pretzel)
Chevrolet Chevette 32 MPG - Carries 4 (32 steps per pretzel)	Ford LTD 12 MPG - Carries 5 (12 steps per pretzel)	VW Bus 22 MPG - Carries 7 (22 steps per pretzel)
Datsun B210 34 MPG - Carries 4 (34 steps per pretzel)	Ford Pickup Truck 12 MPG - Carries 2 (12 steps per pretzel)	
Dodge Van 15 MPG - Carries 8 (15 steps per pretzel)	Cadillac Eldorado 13 MPG - Carries 4 (13 steps per pretzel)	

Step 2

Explain that the students must eat breakfast, go to work, eat lunch, return home, and eat dinner. If anyone runs out of fuel/pretzels, s/he must stay put until this round is over. For Round 1, challenge the students to work in Near Town (point out the sign) and drive his/her own car. Start stepping!

Step 3

Which cars got you to work and home? Which didn't? Discuss alternatives to each driving his/her own car. Students usually suggest car pooling. (The driver of one car can eat each passenger's pretzels as fuel.) For Round 2, distribute new pretzels and travel to Near Town and back, trying car pooling or other suggestions again. Discuss successes and failures.

Step 4

Point out Far Town. Discuss alternatives for reaching this distant city (a bus?). Try it!

General Rules

1. Three or four people may car pool.
2. Car poolers must drive their own cars.
3. Everyone must eat breakfast, lunch, dinner.
4. Fuel pretzels may be shared by car pool members or they may take turns driving.
5. A bus or train can carry everyone.
6. A bus gets six MPG and carries 47 people.
7. A train gets two MPG; one car carries five people.
8. Passengers can take turns driving the bus or train so they can eat their own pretzels.

Note: Some cars carrying six or seven passengers will get better passenger MPG's than buses will.

FOLLOW-UP

What happens when a foreign nation owns most of the pretzels? Design a similar game using other resources.

Adapted from *Spaceship School*

HOW DOES YOUR GARDEN GROW?

DESCRIPTION

Students assess all of the energy that goes into a garden. Several types of gardens are detailed.

OBJECTIVE

C-1. To understand that continuing supplies of energy are essential for the maintenance of life in both natural and built environments.

PURPOSE

To show that energy consumption is essential for the maintenance of natural and built environments.

Time	**Where**
1 hour	Classroom
Topics	**Materials**
Gardening, human ecology, energy	None

LEAD-UP/PREPARATION

Ask students to note the really nice gardens in the community.

Q: How much work went into the creation of the garden? How much planning?

Q: What is the most attractive feature of the garden? What is the most unique feature?

ACTIVITY

From your students' own experience, or by interviewing the grounds keeper at school or the keepers of the unique and wonderful gardens in your community, have your students brainstorm a list of the steps in the creation and maintenance of a good garden.

Step 1

List these on the board:

Q: How many of these require energy?

Q: What sorts of energy?

continued

Q: Is the energy mostly human energy, or is it mechanical energy, or energy from engines and motors, or is it chemical energy?

Q: Is it all of these kinds of energy in varying proportions?

Q: Water is a major factor in gardens, even in water-conserving desert and native plant gardens. How is energy used to provide water to a garden? Don't forget the energy that goes into pumping and into building our state's water systems. Don't forget the energy used in aeration and purification of our water supply. What are some methods commonly used to make a garden more water conserving? (Use of native plants, weed control, mulching.)

Step 2

Assign one garden function to each student; for example, weeding.

Q: What is the purpose of this activity? (To remove undesirable plants from the growing area for aesthetic reasons and also to prevent competition with more desirable plants.)

Q: What energy is involved in this activity? (Human energy for pulling weeds, mechanical energy in the use of the hoe and other weeding tools, chemical energy of commercial defoliants.)

Q: Is this job necessary? (Yes, if the weeds are really interfering. Some gardens use a meadow concept wherein anything that grows is considered natural and part of the community. A weed is only a weed by definition.)

Q: What are the environmental consequences of this activity? (The use of chemicals may have long-term deleterious effects. Weeding also creates garbage piles. Weeds can be composted.)

Step 3

Have the class share its results.

Q: What are the class recommendations if it wanted to plan an environmentally sound garden? A garden to grow food? A rock garden? A showy flower and shrub garden? A natural garden of native plants? A garden for ecological study?

FOLLOW-UP

1. Have your class present a proposal for a garden on the school grounds. Do it.
2. Bring in local gardeners or community garden people to speak to the class on the work necessary for good gardening and on the environmental aspects of gardening practices.

LANDSCAPE

DESCRIPTION

Students assess the artist's values through analysis of landscape painting. The works of several American and European landscape artists are suggested for study.

OBJECTIVE

C-2. To understand how both built and natural environments are dependent on the continuous renewal of resources.

PURPOSE

The interdependence of the built and natural environment can be studied through analysis of art. The artist's emphasis often depends on the emotional and material values of his/her time.

Time 1-2 hours	**Where** Classroom
Topics Aesthetics, cultural history, environmental values	**Materials** Pictures of landscape paintings or slides of great landscape art

ACTIVITY

Step 1

Select landscape paintings by some or all of the following late 19th and 20th century artists: Richard Diebenkorn, Leon Feininger, John Marin, Edward Hopper, Winslow Homer, Paul Cézanne, Louis LaBrie, Andrew Wyeth, and Georgia O'Keefe.

Step 2

Share these with your class. Ask:

Q: What do these paintings have in common? How much emphasis is placed on nature and how much is placed on human-made things? How do these artists show the interaction between natural and human-made things? Do these artists have a comforting outlook with respect to nature, or is there an element of fear connected with the natural? What resources are represented in the works?

Step 3

Now take a look at some landscape paintings of earlier times. Artists to look for are Fragonard, Rubens, Canaletto, Millet, the Barbizon School, and the Hudson River School. Ask the same questions as above. What differences are there? Is there some unifying idea present in 20th century art about nature? About humankind's relationship with nature? How dominant is the human figure in these paintings? Compare the old and modern paintings in this regard.

FOLLOW-UP

Compare Western art, as above, with the high 16th century Chinese landscapes. What is the role of the human figure in Oriental art? Investigate the lives of some of the painters listed above. How did events in their lives influence what they painted? Did the politics of the time influence their attitudes towards nature and the built environment?

SNOW USE

DESCRIPTION

Students examine human uses of snow in various regions.

OBJECTIVE

C-3. To understand that built and natural environments are continuously interactive and changes in one area of the environment can cause changes in many other areas.

PURPOSE

To show the interdependence between living and nonliving things in the environment.

Time ½ hour in class, plus student homework	**Where** Classroom
Topics Water, forests, climate	**Materials** None

LEAD-UP/PREPARATION

With your students, generate a list of uses humans make of snow (Snow . . . in some form!). You or one of the students can list these on a chalkboard or flip chart, accepting all offerings. Be sure that human, plant and animal dependence on snowpack for water is mentioned.

continued

ACTIVITY

Step 1

Once the list is fairly extensive, ask the students to group the uses into categories they specify; for example, fun things, useful things, survival things.

Step 2

Divide the students in the class into as many groups as there are categories, and ask each group to investigate and prepare a report to share with the rest of the class concerning that category of snow use. Each group can find out and show on a map some places where the snow for that category of use falls. It can also include in its report a discussion of what must happen, and what people must do, to be able to use that snow; how much snow falls in the area(s) each year on the average (from the National Weather Service); and any problems related to the use of the snow, in whatever the form.

Step 3

After allowing sufficient time for the collection of information, ask each group to report its findings to the rest of the students.

Encourage the students to discuss the findings reported. In addition, ask them to ascertain from the reports:

Q: Which areas of snowfall provide for the greatest number of uses?
Q: Whether any of these uses conflict with each other.
Q: How much human use of snow is related to forested areas compared to areas with other kinds of vegetation, or without vegetative cover of any sort?

FOLLOW-UP

Set up an investigation to demonstrate how changes in the forest influence snowpack:

On a board 3 feet (1 meter) square, create a simulated forest. Use *pieces of dowel or matchsticks* with *paper or sponge to simulate* trees; use pieces of sponge and other materials to simulate low growing vegetation. Place the "trees" close enough to each other to create a closed crown effect, but also leave some natural, irregular openings, with only low-growing vegetation between some groups of trees. Simulate snowfall by lightly sprinkling the "forest" with powdered laundry detergent to an average depth of about ½ inch (1 centimeter).

Observe the forest, with discussion to include:

- Where the "snow" cover is deepest.
- How the "tree canopy" affects the amount of snow reaching the ground.
- What actions could be taken if people wanted to have more snow reach the ground.
- How more snow on the ground would affect the uses investigated earlier.
- Implications for the forest ecosystem of these changes.
- Possible legal and ethical implications of human uses of snow and things done in the forest to influence those uses.

Adapted from *Project Learning Tree*

NOTES

Social Institutions and Decision-Making Activities

SOCIAL INSTITUTIONS AND DECISION MAKING

Issues

Western cultures have historically perpetuated two basic themes through their decisions affecting the environment. One is the concept that humans are dominant over nature, and therefore, free to exploit natural resources for their benefit. The other is a concept of stewardship — that humankind has a responsibility to protect all living things and the land, air, and water. The tension between these two themes is often apparent when environmental issues are debated.

Decisions affecting the environment are usually made within our social arenas. Responsibility for the "public good" is shared by political, legal, economic, educational, and religious institutions. An overview of these major social institutions helps clarify the role of each.

Government has played an increasingly influential role in environmental decision making. Enactment of the National Environmental Policy Act of 1969 (NEPA) established the process for giving environmental concerns consideration in governmental decisions. This act instituted the requirement of environmental impact statements, which mandate the consideration of environmental, as well as economic and technological, concerns in the decision-making process. Laws to control air and water pollution and to expand parks and wilderness areas have also legitimized the concern for a healthy environment. Lobbyists have been influential in shaping our government's environmental policy. Groups such as the Sierra Club, Friends of the Earth, and those representing the interests of developers research the issues and take their cases to governmental representatives. These representatives often listen closely to those with a vested interest in an environmental issue.

Our courts have also played a decisive role in the resolution of environmental issues. The environmental impact statements of NEPA resulted in many suits by environmental groups against federal agencies. In discharging their obligation to interpret the law, the courts have clarified the intent of several environmental statutes.

The business and industry sectors of society affect environmental decisions, not only through lobbying efforts, but through economic enterprises that exploit natural resources. A long-standing debate argues the ethical relationship between business and the environment. Should business be expected to voluntarily engage in practices that diminish its profits? Does business have a responsibility to serve the social good of the community? Business and industry have, without a question, a profound effect on the environment. Yet, whether or not their mechanism for making decisions should consistently include environmental considerations is still largely undetermined.

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Business and industry affect environmental issues from another perspective: that of the worker. Labor organizations have found that, in recent years, environmental concerns are sometimes in concert with our own. Labor and environmentalists lobbied together for a bill that regulates the use of toxic substances. A tension continues to exist, however, in situations such as the expansion of Redwood National Park. Labor worked hard against a decision to expand the park because it believed it would destroy jobs.

The wave of enthusiasm that accompanied Earth Day in 1970 led many people to believe that educational institutions would be able to provide citizens with the ability to make responsible environmental decisions. Educators have had a difficult time, however, defining environmental education and deciding where it fits into the school curriculum. Also, schools usually **reflect** societal trends rather than set them. It has, therefore, been difficult to establish a future's-oriented curriculum within the existing educational structure.

When religious institutions have participated in the environmental decision-making process it has been mostly through their educational mission. Church organizations such as The American Friends Service Committee have advocated for personal lifestyles that reflect a concern for the environment. Other efforts, such as the Interfaith Center for Corporate Responsibility, have attempted to push churches into a more active role regarding environmental decisions.

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Environmental issues are clearly complex. They are directly influenced by a societal concern for economic well-being and the leadership provided by the major social institutions. Each of these institutions must be responsive to social needs and the environment as they work to make decisions that promote the public welfare.

Five concepts have been identified to develop student awareness of Social Institutions and Decision Making. The first addresses the international ramifications based on continuous use of technological/industrial mode. The second addresses (1) the basis for economic prosperity that can be established through more efficient use of natural resources, and (2) the effects that unlimited short-term prosperity can have on long-term goals for ourselves and for future generations. The third concept addresses decision making about the environment — who makes decisions and how they are made. The fourth concept addresses the identification of sources of information about environmental problems and the real and potential influences which they have in helping to resolve these problems. The final concept addresses the nature of the regulations which are now in effect for controlling use of the environment, how regulations are formulated, and the role of individuals in assuming responsibility for participating in the resolution of environmental problems.

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NOTES

SOCIAL INSTITUTIONS AND DECISION MAKING

MAJOR CONCEPTS	OBJECTIVES
A. Environmental problems transcend political entities, state and national boundaries, and cultural differences.	1. To understand how technological advancement and industrial expansion throughout the world are creating massive changes in the environment that have worldwide effects.
	2. To understand that population growth in all parts of the world is creating an unprecedented demand for the consumption of natural resources.
	3. To understand how national self-interests and societal values and ethics influence international collaboration on environmental issues.
B. The goals for every society include economic prosperity which is based, in part, on the consumption of natural resources.	1. To understand that technology for recycling and renewing resources, developing new resources, and discovering alternative uses for existing resources is critical for maintaining and improving our health, welfare, and economic prosperity.
	2. To understand how short-term and long-term effects can influence economic decisions related to the use of the environment.
C. Individuals and private groups within our society play important roles in developing public awareness of environmental issues and in monitoring public and private activities in relation to the environment.	1. To understand how interest groups express the values, ethics, and understandings of subgroups within our society.
	2. To understand that interest groups are established to participate in the political process and to influence public policy and lawmaking.
D. Educational institutions and communications media are potential sources for the creation of public awareness of environmental issues.	1. To understand that communications media through reporting, advertising, and other programming can widely influence public attitudes about the environment.
	2. To be aware that a variety of public and private organizations provide educational programs to influence public opinion about the environment.
	3. To be aware of the various avenues which are available for individual expression of concerns about the environment.
E. Environmental law is intended to regulate use of the environment for present and future generations.	1. To understand that governmental agencies at state and national levels monitor the environment, make recommendations for laws, and monitor the implementation of the laws.
	2. To understand that environmental laws reflect a great many factors, such as economic consequences to an industry, technological development, and short-term and long-term consequences for the environment.
	3. To understand that the effectiveness of environmental law is dependent on the extent to which individuals and groups accept responsibility for the care of the environment.

SOCIAL INSTITUTIONS AND DECISION MAKING OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand how technological advancement and industrial expansion throughout the world are creating massive environmental changes that have worldwide effects.	Students interview elderly people from the community.	Through demonstrations and discussions of air and water movement, students discover how pollution can travel from one place to another.	Students use math and map study to outline the impact of land development on wildlife populations.	Students brainstorm positive and negative effects of off-road vehicles (ORVs). Students create lists for the more responsible use of ORVs.
	2. To understand that population growth in all parts of the world is creating an unprecedented demand for the consumption of natural resources.	Students count the number of people in the last two generations of their families. They discuss populations and the need to share resources.	Students simulate how rich and poor countries try to provide for the basic needs of their citizens.	Students participate in a global meal where 1/3 of the group eats an American meal, and 2/3 eat a Third World meal.	In a simulation game, Malthusian principles are demonstrated.
	3. To understand how national self-interests, and societal values and ethics influence international collaboration on environmental issues.	Through artwork and discussion, students describe and examine attributes of groups.	Students compare the belief systems and resultant behaviors of a Native American group and early settlers.	Students consider several hypothetical public policy decisions on food production from disparate points of view.	In a simulation game, students act as a committee gathered from different nations to erect an environmental monument.
CONCEPT B	1. To understand that technology for recycling and renewing resources, developing new resources, and discovering alternative uses for existing resources is critical for maintaining and improving our health, welfare, and economic prosperity.	Students learn additional verses to the song "It's a Small World."	Students look at long- and short-term effects of choices they make in purchases. Alternative lists are brainstormed.	Students consider packaging and its effect on the environment. They take a poorly designed package and redesign it.	Students design a segment of one community and take into account economic, energy, environmental, and aesthetic considerations.
	2. To understand how the short-term and long-term effects of resource use can influence related economic decisions.	Students sort and examine classroom waste and recycle selected items.	Students devise other uses for common items in a format game.	Students discuss a fictional work related to the use and abuse of natural resources.	Students examine the pros and cons of packaging in the fast food industry and make recommendations.
CONCEPT C	1. To understand how interest groups express the values, ethics, and understandings of subgroups within our society.	Students sort themselves according to physical attributes and opinions.	Students make a list of appropriate behaviors in outdoor settings. They look at them from the viewpoint of various interest groups.	Students role-play a city council meeting in which they must choose to fund only one of three environmental projects.	Students design logos representing interest groups concerned with environmental issues.
	2. To understand that interest groups are established to participate in the political process and to influence public policy and lawmaking.	Students learn about and make models of endangered animals.	Students create a story from facts only with interest groups viewpoints attached.	Students design a coat of arms representing a citizen's group, governmental agency, etc., concerned with the environment.	Students read position papers put forth by groups on the issue of overpopulation of deer in a small California park.
CONCEPT D	1. To understand that communications media through reporting, advertising, and other programming can widely influence public attitudes about the environment.	Students play describing games to see how well they can communicate a simple message. TV ads are analyzed.	Students role-play different propaganda techniques and examine advertisements for bias.	Students collect energy ads, discuss their purpose and effectiveness, and then design an energy conservation billboard.	Students detail some of the techniques used in the media to influence thought and opinion.
	2. To be aware that a variety of public and private organizations provide educational programs to influence public opinion about the environment.		Students write an editorial on land use in a hypothetical locality.	Students analyze environmental education curriculum materials for bias and manipulation.	Students write for their own class, lesson plans reflecting the biases of selected interest groups.
	3. To be aware of the various avenues which are available for individual expression of concerns about the environment.	Students express their feelings about a forest environment through creative dramatics.	Students examine ways of expressing their environmental concerns and then actually "make a statement."	Students choose an issue and write a petition to bring about change.	Students use a model letter form and write to those who have power over an environmental issue.
CONCEPT E	1. To understand that governmental agencies at state and national levels monitor the environment, make recommendations for laws, and monitor the implementation of the laws.	Students examine a classroom problem and the effectiveness of rules.	Students inspect a map showing the land area designated as public parks and open spaces and identify the origins of these designated areas.	Students conduct a mock trial involving thermal pollution of a stream from a nuclear power plant.	Students hold small group meetings to prepare statements on the use of national forest lands for vacation homes.
	2. To understand that environmental laws reflect a great many factors, such as economic consequences to an industry, technological development, and short- and long-term consequences for the environment.		Students take part in a land use planning decision concerning a newly formed lake.	Students simulate an EPA hearing on the use of DDT on the spruce budworm.	Students collect information in a school survey to determine how their school functions, what the power structure is, and who makes the rules.
	3. To understand that the effectiveness of environmental law is dependent on the extent to which individuals and groups accept responsibility for the care of the environment.		Students attempt to equitably divide coastal waters out to a 200 mile (320 km) limit.	Students predict what would happen to a vacant piece of land in the community which was owned in common.	Students analyze the actions of individuals in the environment and make value judgments.

PREDATOR/PREY

DESCRIPTION

Students use math and map study to outline the impact of land development on wildlife populations.

OBJECTIVE

A-1. To understand how technological advancement and industrial expansion throughout the world are creating massive environmental changes that have worldwide effects.

PURPOSE

To show that through the growth of the built environment, and its attendant technology, people are making massive changes in the environment.

Time 1-2 hours	**Where** Classroom
Topics Wildlife, resource management, land use	**Materials** Local road maps

LEAD-UP/PREPARATION

Prepare the given information below and the problems as a handout.

ACTIVITY

Assign the problems below for classwork:

Step 1

Given the information provided, students may solve the problems posed.

Given

One mountain lion can eat approximately 1,095 pounds (490 kilograms) of venison (deer meat) each year (in addition to rabbits, porcupines, and other small animals). The mountain lion probably consumes only about 50 percent of each deer it kills; coyotes and other scavengers get the rest.

One deer eats approximately 3,650 pounds (1652.5 kilograms) of vegetation per year in the form of grasses, herbs, brush, and tree leaves. One square mile (kilometer) of deer habitat produces 800 pounds (320 kilograms) of vegetation acceptable as deer food per year. (Note: This varies depending on the region, condition of the range, and other factors.)

Problems

1. What is the minimum number of square miles (square kilometers) of habitat needed to support one deer?
2. If each deer averages 150 pounds (70 kilograms) in weight, how many deer are needed to feed one mountain lion for one year?
3. How many square miles (square kilometers) of deer-lion habitat are necessary for one lion to survive? (For the purpose of this problem, assume that one deer and one mountain lion will provide continuation of the species, although continuation would require many animals.)

4. Use a map of a region you are familiar with and outline an area large enough to serve as habitat for one mountain lion. Ignore all roads, communities, and other developments which do not produce food for deer.
5. On the same map, again outline an area large enough to support one lion, but this time take into account the non-deer food producing areas. How much larger is the second area you outlined?
6. Notwithstanding all the development present in the United States today, there are more deer in this country now than there were when the first European settlers arrived. How can you explain this? Find out what impact the growth of the deer population has had on other species of wildlife.

Step 2

Q: What can we do to preserve habitats?

Q: Where do the rights of people to have a home, place of business, etc., stop, and the rights of the environment to survive in a natural form begin? Should people have the right to have natural areas to visit?

FOLLOW-UP

Define a local habitat problem. What habitats are being destroyed by development in your community? What are the benefits of development?

Adapted from *Project Learning Tree*

GLOBAL MEAL

DESCRIPTION

Students participate in a global meal where one-third of the group eat a "U.S. meal" and two-thirds eat a "Third World meal."

OBJECTIVE

A-2. To understand that population growth in all parts of the world is creating an unprecedented demand for the natural resources.

PURPOSE

To demonstrate, on an emotional as well as an intellectual level, the inequalities of global food distribution.

Time
Approximately 1½ hours

Topics
Food, famine, global perspectives, cultural history

Where
Cafeteria or classroom

Materials
U.S. meal, such as soup, salad, meat, vegetables, dessert and beverage; Third World meal, such as rice or oatmeal and powdered milk; Nation Cards: one third U.S., two thirds Third World (see below); CARE hats (optional), tables, tablecloths, candles, dishes, eating utensils.

LEAD-UP/PREPARATION

This activity must be carefully planned as a special event. Two meals must be prepared simultaneously; if you have cooperative parents, the U.S. meal might be potluck (however, be sure they understand the purpose of the lesson and that their child might not be in the U.S. group).

Prepare Nation Cards: one-third should say "United States" or the names of other Western developed countries (Germany, Great Britain, Canada). Two-thirds should give the name of a lesser-developed country, such as Bangladesh, Nigeria, India. *Optional:* collect and label helmets or hats with CARE signs.

continued

ACTIVITY

Step 1

As students enter the room, hand each a Nation Card. Instruct students representing the U.S. to sit at the tables with tablecloths, candles, and place settings. Instruct students with Third World cards to sit on the floor.

Step 2

Serve food to the U.S. tables (use parents, aides, or student helpers to act as waiters). Then serve rice and milk to Third World students. Have these "waiters" wear CARE hats and ladle out small portions from a large pot or bucket.

Step 3

Allow time for both groups to eat their meals. Monitor reactions for later discussion. (See Trouble-Shooting.)

Step 4

Once the meal has ended, bring the groups together to discuss reactions:

Q: Can you describe what we just did?
Q: How did this experience make you feel?
Q: What was the role of the CARE person?
Q: Why does the U.S. eat differently from lesser developed countries?
Q: How do our food habits affect how other countries eat?
Q: What might we do to make global food distribution more equitable?

FOLLOW-UP

1. Show the movie *Toast*—available through some media centers or from Bullfrog Films, Oley, PA 19547, phone (215) 779-8226. This film traces the energy and resources that go into making a slice of bread.
2. Another positive follow-up activity is to make and eat a meal together that is made up of foods that are low on the food chain (only fresh fruits and vegetables, low or nonprocessed foods).

TROUBLE-SHOOTING

It might be a good idea to have supplemental food on hand for the Third World group to eat *after* the discussion. This makes the activity less realistic; but it may be necessary if that group is still hungry.

Monitor *Step 3* carefully. Be prepared for Third World students who may try to steal food from the U.S. table. Perhaps assign one person as a sergeant-at-arms to make sure things don't get out of hand.

Adapted from *Shaver's Creek Environmental Center*

HOW WOULD YOUR LIFE BE AFFECTED?

DESCRIPTION

Students consider several hypothetical public policy decisions on food production from disparate points of view.

OBJECTIVE

A-3. To understand how national self-interests and societal values and ethics influence international collaboration on environmental issues.

PURPOSE

To help students consider the personal effects of policy decisions by putting themselves into others' situations.

Time 45 minutes	**Where** Classroom
Topics Food, insects, resource management, environmental values	**Materials** 1 per student: reproduction of problem situations (see below)

LEAD-UP/PREPARATION

Select the problem situations to be considered by the class. Reproduce enough copies of the problems selected so each student has one. If there is not enough time to consider all five problems, assign different problems to small groups and report their conclusions back to the class.

ACTIVITY

Step 1

Determine a group leader and recorder for each group. The position may rotate as each problem is considered.

Step 2

Provide the participants with a problem situation. Direct the group leader to read the situation aloud as the participants read silently, and then consider the problem by asking themselves: "How would my life be different if this policy were adopted?" The recorder should write down the responses of the group.

Step 3

After they have considered how the situation might affect them personally, the students are asked to imagine themselves in the place of other designated persons and to answer the same question. The recorder should record the group's consensus after considering the policy from each point of view. Discourage stereotyped portrayals.

Step 4

After discussing the policy from several vantage points, the group should summarize the advantages and disadvantages of the policy as it sees it.

Step 5

Have each group share its summary with the class.

FOLLOW-UP

Debates, role-playing, and written essays may be encouraged in relation to any or all of the situations.

TROUBLE-SHOOTING

In the discussion, note any changes in attitudes that emerge as students consider the impact of various policies on persons other than themselves.

PROBLEM SITUATIONS

1. The United States government has decided that Americans eat too much meat, and that the grain fed to meat-producing animals should be more directly used by humans. The government plans to buy up all surplus grain from farmers and distribute it to countries with large numbers of starving people. Furthermore, the government has taken all meat production under its jurisdiction and has made it unlawful for private citizens to raise meat producing animals for their personal consumption. Meat will be rationed by

continued

limiting the purchase of meat to $1.50 a week per family member.
Under this policy, how would your life be different if you were:
- Yourself
- A beef farmer
- A congressperson
- A person from one of the countries receiving the grain
- A grain farmer
- A grocery store owner
- A meatpacker

2. The United Nations predicts that the world population will continue to increase, and that the world food supply will reach its maximum productivity in three years. It will then begin to decline because much agricultural land will have been lost due to urbanization and misuse. Productivity will be further impaired because chemical fertilizers will be increasingly expensive. Accordingly, the United States government has decided to stop all exports of chemical fertilizers to insure their availability for domestic agriculture.
   Under this policy how would your life be different if you were:
   - Yourself
   - A foreign farmer
   - A child in a large family in India
   - A United States farmer
   - A poor American
3. Congress has been persuaded by environmentalists to pass legislation which bans the use of pesticides in United States agriculture.
   Under this policy, how would your life be different if you were:
   - Yourself
   - An animal
   - A farmer
   - A stream
   - A low-income consumer
   - An environmentalist
   - A pesticide producer
4. In order to conserve fossil fuels, Congress has decided to ration their use in agriculture. This rationing measure will cut food production by 25 percent.
   Under this policy, how would your life be different if you were:
   - Yourself
   - A farmer
   - A chef in a restaurant
   - A starving child
5. The government has decided to aid an overpopulated country in which starvation prevails. It plans to provide agricultural technology and equipment and hybrid seeds. The country will help build adequate storage and transportation facilities.
   In order to finance this policy, a 5 percent federal tax has been placed on all food in the United States.
   Under this policy, how would your life be different if you were:
   - Yourself
   - An American grocer
   - A restaurant owner
   - A citizen of the aided country
   - An agricultural expert sent to aid the cause

Adapted from *Personal Values and Environmental Issues*

ENERGY PACK

DESCRIPTION

Students consider packaging and its effect on the environment. They choose a poorly packaged product and redesign the package.

OBJECTIVE

B-1. To understand that technology for recycling and renewing resources, developing new resources, and discovering alternative uses for existing resources is critical for maintaining and improving our health and economic prosperity.

PURPOSE

To illustrate that a product may have wide-ranging environmental effects.

Time Two 30-minute periods followed by one 45-minute period	**Where** Classroom
Topics Renewable resources, economics, consumer ecology	**Materials** Chart for each student

LEAD-UP/PREPARATION

Collect and bring into class several examples of items you consider to be "over-packaged." Try to decide whether the amount of packaging is justified because of transportation hazards, protecting the quality of the product, sanitation, ease of use, or convenience for the customer.

Q: Which of these packaging materials cause the least destruction to the environment? Why?

Q: Which of these packaging materials are from nonrenewable resources?

Q: Which of these packaging materials are recyclable?

Q: Which are biodegradable?

Q: Which contain specific hazards to the environment? (e.g., fish eating pop tops, birds getting their necks caught in plastic six pack holders.)

Reproduce the packaging chart so each student will have as many as s/he needs.

ACTIVITY

Step 1

Direct students to save all the packaging materials that come into their house on one major shopping day.

Step 2

Make a chart listing all the packaging materials as follows:

Item	Packaging Material	Non-renewable Resource	Renewable Resource	Recyclable	Biodegrad-able	Uses a lot of energy to prepare	Uses little energy to prepare

Step 3

On the day the charts are brought to class, brainstorm alternate methods of packaging that would have less impact on the environment.

Step 4

Direct each student to pick one product s/he considers "over packaged" and redesign a package for that product considering:

- Environmental impact
- Attractiveness
- Cost
- Aid to using the product
- Health and safety hazards

Step 5

Let each student explain his/her design to the class.

continued

FOLLOW-UP

1. Conduct a contest with students voting on the most environmentally sound, most attractive, most likely to be purchased, most creative. . . giving awards to the winners.
2. Provide students with the addresses of the "over-packagers" discussed in class. Help them write letters to the companies expressing their feelings about the packaging of their products.

TROUBLE-SHOOTING

There are bound to be some favorite over-packagers especially attractive for one reason or another. Direct the design project so there is variety not only in products selected but also in the kind of products. Be sure to include some food items, drug items, household items, etc., that will present different problems in handling.

Adapted from *The Green Box*

THE CONTINUING ADVENTURES OF THE TRUFFLE TREE COMPANY

DESCRIPTION

Students discuss a fictional work related to the use and abuse of natural resources.

OBJECTIVE

B-2. To understand how short-term and long-term effects of resource use can influence related economic decisions.

PURPOSE

To illustrate the complex relationships between developing resources and maintaining the environment and economic prosperity.

Time	**Where**
One 45-minute period	Classroom
Topics	**Materials**
Resource management, interdependence	*The Lorax,* either in book or movie form

LEAD-UP/PREPARATION

The Lorax, a children's book by Dr. Seuss, describes the deterioration of an environment because of reckless exploitation of "truffle trees" to produce "thneeds" to meet the incessant demands of consumers. The book has also been made into a film by the same title. *The Lorax* is sometimes shown on television, and is often available through local media centers and organizations. Make *The Lorax* available to your students in some form.

ACTIVITY

Step 1

Discuss the general story line, and then explore questions like these:

Q: What seems to be the author's intent in writing this book?

Q: Are any of the ideas in the book similar to real situations? What people, what resources, and what issues?

Q: Describe any values which appear to be important in the story. Identify any present-day counterparts to these values. Are any of these values in apparent conflict? If so, which ones? And for what apparent reasons?

Q: Does *The Lorax* appear to have been written for young children, for their parents, or for both? Why?

Q: Are any of the ideas presented in *The Lorax* important to you in your daily life?

Step 2

After discussion ask the students to identify ways, if any, in which they might modify their own lifestyles to ensure more effectively a long-term quality environment.

FOLLOW-UP

Have the students write and illustrate sequels to *The Lorax* (in common English if they wish). The sequels might explain what the authors, as new presidents of the Truffle Tree Company, are going to do to maintain a quality environment, at the same time ensuring the continuing growth and availability of "truffle trees." Ask students to share sequels in class:

Q: Of those programs suggested in the sequels, what are the social and economic implications that will ensure a quality environment? Who will pay for environmental protection? Who will pay for damage to the environment?

Q: Which sequel seems to be closest to our current lifestyle?

Q: Do either the original story or the sequels portray the forest industry today? Any other industries?

Adapted from *Project Learning Tree*

IT'S YOUR CHOICE

DESCRIPTION

Students role-play a city council meeting in which they must choose to fund only one of three environmental projects.

OBJECTIVE

C-1. To understand how interest groups express the values, ethics, and understandings of sub-groups within our society.

PURPOSE

To help students realize that environmental issues often force people to make choices and that all people do not agree on what choices are appropriate.

Time	**Where**
One to two 45-minute periods	Classroom
Topics	**Materials**
Environmental values, recreation, preservation	1 per student: a copy of city council situation (see below); 1 per group: decision sheet (see below)

LEAD-UP/PREPARATION

1. Discuss environmental decisions that students may be aware of; e.g., expansion of Redwood Park, protecting the coast, 55 mile per hour speed limit, smog controls on cars, etc. List as many as they can think of.
2. Considering each decision separately ask:
   - What people or groups would be in favor of this decision? Why?
   - What people or groups would be opposed to it? Why?
3. Explain how difficult it is sometimes to make the best decisions, and how the class will have a chance to practice decision making.

continued

SOCIAL INSTITUTIONS AND DECISION MAKING

ACTIVITY

Step 1

Divide your class into groups of four or five students. Give each student a copy of the document describing the city council situation:

> The end of the year was fast approaching. The city manager of your city announced that there would be a sizeable sum of money left over at the end of the year. However, according to state law, all monies left unspent have to be returned to the state treasury.
>
> You are a member of the city council. You have long hoped for extra money to be available to spend. For years you have sought support for three of your pet projects. In fact, just last year the city council voted to spend any extra money for your projects. Now it appears your three projects will be funded. You have wanted the money to:
>
> - Build bike paths
> - Build and operate a park and small animal zoo
> - Purchase a large piece of land as a natural wildlife refuge
>
> This evening the city council is meeting for the last time this year. The decision to spend the money must be made tonight.
>
> You have already reminded the council members of their vote 12 months ago to fund your three projects when the money was available. It appears the money is now available.
>
> As the city manager begins the meeting, your dreams are shattered. Only one-third of the money that was thought to be available was still left unspent. Of your three projects, only one can be funded. The council members inform you that they can and will spend the money on one of your projects. It is your choice. However, they cannot promise or guarantee that extra money will be available next year or the next. To delay your decision would force them to fund other projects proposed by other members of the council. In other words, if you decide not to make a choice, you will get none of your projects funded. Should you decide on one of the three, you may never get your other two projects funded. The council members agree that you must choose from the three projects you have long supported. You must choose one of the following:
>
> - To build the bike paths
> - To build and operate a city park and small animal zoo
> - To purchase land for a natural wildlife refuge

Step 2

After each group has had a chance to read the description of the situation, discuss it to assure initial understanding of the context.

Step 3

Now, instruct each group to make a choice and come to a decision. Distribute the decision sheet below to each group so that it may record its answers.

Step 4

After the decision sheets are completed, hold a class discussion to compare and contrast the various group decisions. The following questions might help to serve as discussion starters:

Q: Remembering that bicycle paths would lead some motorists to stop driving to work, which of the three projects would be the most protective of the environment?

Q: How might one associate the concept of conservation to the wildlife refuge project? The small animal zoo project? The bike path project?

Q: Which project would reflect the "wisest" use of the *money* available to spend?

Q: Is it bad that projects such as those listed were not already funded by the city council?

Q: What projects that operate to preserve and protect the environment are already supported by your city's government?

Q: The building of roads and parking lots has been condemned by many environmentalists. Would an environmentalist who worked against the building of roads support the bike path project?

FOLLOW-UP

Instruct each student to write a letter to the editor of the local paper explaining his/her vote on the city council's environmental project to his/her constituents.

Adapted from *Environmental Education Activities Manual*

Decision Sheet

Directions: Members of your group are to agree on one of the three options offered to you as a Council member. You should seek some basis for agreement. This means that you are *not* to vote. Instead you must reach a common conclusion that all members of your group are willing to accept and support.

The three possible projects that could be funded by the Council are:

1. ______________________________
2. ______________________________
3. ______________________________

Of these three projects, the best project is:

____

If asked to provide our (my) grounds for making this decision, we (I) would say:

____

____

____

____

The person(s) responsible for making this decision are:

____

____

____

A COAT OF ARMS

DESCRIPTION

Students design a coat of arms representing a citizens' group concerned with the environment.

OBJECTIVE

C-2. To understand that interest groups are established to participate in the political process and to influence public policy and lawmaking.

PURPOSE

To help students understand the roles and responsiblities of government agencies and special interest groups in public policy decision making.

Time
Introduction: 15 minutes
Activity: Two 45-minute periods

Where
Classroom

Topics
Conservation, citizens' groups, environmental legislation

Materials
Butcher paper, pens, pencils, paints

LEAD-UP/PREPARATION

This country was founded on the principle that each of its citizens has the right to participate in the policy-setting and decision-setting processes. Then, as government bureaucracies grew in size and became more centralized, decision making was left increasingly to the "experts." Recently, however, the citizen-group movements, exemplified by Common Cause and consumer advocate groups, have sought to regain some of these participatory rights. This trend has clearly been evident in issues and policies affecting the environment. Early in this century, there were only seven national and two state conservation organizations. By 1960, these numbers had grown to 78

continued

national and 236 state organizations, and the 1977 *Conservation Directory,* published by the National Wildlife Federation (see bibliography), lists 342 international, national, and interstate organizations and commissions and 177 state and territorial agencies and citizens' groups concerned with natural resource use and management.

Q: What are some environmental groups? List the responses on the board.

Q: Can you think of some government agencies involved with supervision of the environment? Make another list of student responses.

Q: What industry groups are concerned with governmental policy on the environment and/or with the environment itself? Make a third list.

Q: Lastly, what about sport or hobby groups? Record the fourth list on the board as well.

ACTIVITY

Step 1

Divide the class into groups of three or four students each. Direct each group to select a specific conservation group, government agency, industrial organization, or sports group it would like to investigate. Record the choices on the board to avoid duplication.

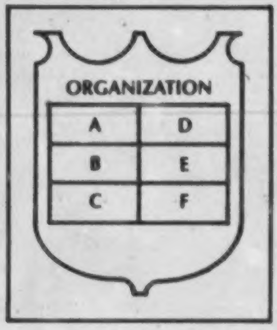
Step 2

Assign each group the task of designing a coat of arms for its selected organization. The coat of arms should have six sections, each with a symbol representing:

A Coat of Arms

- The public's opinion of the group
- The group's greatest concern
- The group's overall goals
- What the group sees as the greatest obstacle keeping it from achieving its goals
- What the group thinks the world would be like without it
- The image the students have of the group

The symbols could be arranged on a large paper shield to look like this:



Step 3

Ask students to organize their coat of arms. Some research will be necessary.

Step 4

Allow time for each group to share its coat of arms with the rest of the class.

Step 5

Use the coat of arms as a basis for discussion.

Q: What is the value of these groups in our society?

Q: How can groups like these be harmful?

Q: Do citizens' groups seem to represent the public interest any better than government agencies or private industry?

Q: Does the decision-making process appear to be improved or impeded by input from citizens' conservation groups?

Q: Are quick decisions good or bad? Are slow decisions good or bad?

Q: What conditions determine whether a decision concerning the environment is good or bad?

FOLLOW-UP

Invite a local representative from one of the studied groups to visit your class. Involve the entire class in composing key questions to be asked by four students in a Meet the Press type of interview with the guest. Schedule the interview so that there will be time left for other class members to ask spontaneous questions from the floor.

Adapted from *Project Learning Tree*

ENERGY ADS

DESCRIPTION

Students collect energy advertisements, discuss their purpose and effectiveness, and then design their own energy conservation billboard.

OBJECTIVE

D-1. To understand that communications media, through reporting, advertising, and other programming, can widely influence public attitudes about the environment.

PURPOSE

To discover the relationship between energy shortages and advertisements for business products.

Time
Two 45-minute periods

Where
Classroom

Topics
Energy, environmental values, consumer ecology

Materials
Energy advertisements; paper, paints, etc., for billboard

LEAD-UP/PREPARATION

Collect energy advertisements from newspapers and magazines. Include ads not only from energy companies but also from those businesses highly dependent on energy, such as the automobile industry and farming.

ACTIVITY

Step 1

Use the energy industry advertisements as a basis for discussion.

Q: What seems to be the overall message of each advertisement?

Q: Are the arguments of the energy companies persuasive? Why or why not?

Q: Why do some of the ads "turn you off" or "turn you on"?

Q: Why would energy industry advertisements call for conservation? (One possible answer: Power companies can no longer meet the growing demands of people for energy.)

Step 2

Q: Are there ads that reflect a change because of an energy shortage (cars emphasizing mileage instead of luxury)?

Q: Do you think ads like these change people's opinions and behaviors?

Step 3

Create a billboard advertisement for your school which stresses conservation of energy.

FOLLOW-UP

1. Design a cover for a new conservation magazine or industrial magazine (your choice) to be called EN-ER-GEE.
2. Write an advertisement to appeal to new subscribers for your new magazine.
3. Write the first energy editorial for EN-ER-GEE.
4. Write a letter to the editor of EN-ER-GEE.
5. Write an article for EN-ER-GEE which describes, to your future son or daughter, the present energy situation and what you are doing about it.
6. Illustrate your article.
7. Write your child's reaction to your letter.

Adapted from *Energy and My Environment, 7-9 Teacher's Guide*

BIAS IN THE CLASSROOM

DESCRIPTION

Students analyze environmental education curriculum materials for bias and manipulation.

OBJECTIVE

D-2. To be aware that a variety of public and private organizations provide educational programs to influence public opinion about the environment.

PURPOSE

To examine ways that public and private organizations attempt to influence public opinion about the environment through educational materials.

Time 2 half-hour sessions (can be broken down into short segments)	**Where** Classroom
Topics Consumer ecology, economics	**Materials** For each student: a list of "What Kinds of Resources You'll Get" (see below)

LEAD-UP/PREPARATION

1. Collect a variety of curriculum materials that teach environmental concepts. Include materials produced by industry, environmental groups, state and federal agencies, etc.
2. Copy the list of "what kinds of resources you'll get" for each.

WHAT KIND OF RESOURCES YOU'LL GET

- **Propaganda**—Materials to indoctrinate critics regarding an agency's practices or purposes.
- **Public Relations Stuff**—Materials to inform the public of the agency's efforts and perhaps gain its support.
- **Technical**—Usually internal or service documents designed for training. Sometimes the training is aimed at increasing sales or service but not usually.
- **Advertising**—Similar to public relations "stuff" but directed specifically at gaining greater sales or service use.
- **Reports**—These are documents outlining an agency's activities, usually for an advisory or funding agency (legislative reports, annual reports to stockholders, etc.).
- **Education/Information Documents**—These documents vary greatly in purpose and quality. It is sometimes difficult to separate these materials from those previously described. Most often the documents aim at providing "facts" about an agency, some aspect of its work, or some area of its expertise. Very often, the conclusions are developed and offered within the document.

ACTIVITY

Step 1

Divide the class into teams of five. Give each group five or more samples of different curricula.

Step 2

Select and list as many impressions as possible that your group has from exploring the resource materials.

Step 3
Now, look at your list. See if you can group or classify your impressions; link as many things together as you can, for whatever reason you can. Allow another few minutes for sharing. Look at the list of "What Kinds of Resources You'll Get." Where do your materials fit in?

Step 4
Examine your materials for hidden assumptions and/or attempts to manipulate the reader's thinking. Which assumptions do you agree with? Which do you disagree with? Choose one example to share with the class.

Step 5
Using the resource materials available to you, create a commercial for some environmental aspect or issue. Present it to the class.

Step 6
Regroup the entire class. Discuss who produces environmental education materials.

Q: Should we use biased materials?
Q: How can we ensure getting both sides of an issue?
Q: Why is that important?
Q: Do you think it is possible for anything to be without bias? Is balance the solution to the bias problem?

FOLLOW-UP

Think about future environmental education materials. Imagine what future publications might be like, based on your predictions of environmental concerns.

Adapted from *USE THIS*

WRITING A PETITION

DESCRIPTION

Students choose an issue and write a petition to bring about change.

OBJECTIVE

D-3. To be aware of the various avenues which are available for individual expression of concerns about the environment.

PURPOSE

To introduce an avenue for expressing concern about an issue.

Time Approximately 3 hours, spread over 2 weeks	**Where** School and neighborhood
Topics Environmental legislation, environmental values	**Materials** Sample petitions and information from several current issues

LEAD-UP/PREPARATION

Gather sample petitions and/or information about current issues that affect the environment, such as the support or lack of support for governmental actions (e.g., Peripheral Canal, dam projects) or promotion of new ideas (secession of Northern California), etc.

ACTIVITY

Step 1
Display petitions and discuss:

Q: What purpose(s) do petitions serve in an effort to bring about change?
Q: What other methods do individuals and groups use in their efforts to bring about change?
Q: On what issues might we draft a petition in order to bring about change?

continued

Step 2

Ask the group to choose one or more issues that it would like to examine. (If there is one issue students seem especially concerned about, use only one. If there is interest in several issues, allow students to group themselves according to interest around a common issue.)

Step 3

Allow time for students to gather information about the selected issue(s); then draft and circulate a petition supporting one side of the issue.

Step 4

Q: Was it easy to gather signatures? What techniques were especially effective?

Q: Who signed our petition(s)? Older folks, students, parents, or a wide mixture?

Q: What might we have done differently to get more signatures?

FOLLOW-UP

Send the petition to an appropriate official.

Make a statement about the same issue, through artwork. Post artwork around the school.

THERMAL POLLUTION: A MOCK TRIAL

DESCRIPTION

Students conduct a mock trial involving thermal pollution of a stream from a nuclear power plant.

OBJECTIVE

E-1. To understand that governmental agencies at state and national levels monitor the environment, make recommendations for laws, and monitor the implementation of the laws.

PURPOSE

To introduce the legal process used for resolving environmental issues.

Time Introduction: 15 minutes Trial: 45 minutes	**Where** Classroom
Topics Water pollution, nuclear fission, environmental regulation	**Materials** 1 per student: a summary of the case (see Lead-Up/Preparation)

LEAD-UP/PREPARATION

A summary of a case from *The Environmental Law Reporter,* March 1975, follows:

Jersey Central Power and Light operates a nuclear-powered electric plant located between the Forked River and Oyster Creek, a tidewater stream emptying into the Atlantic. A canal carries water from the Forked River to the plant. At that point, pumps force the cold river water beneath the plant, where it passes around condensers located underneath the nuclear reactors. This water, acting to cool and condense the steam created by the reactors, becomes heated some 25 degrees in the process. The heated water is then pumped into a canal that empties into Oyster Creek.

The artificially-warmed water of Oyster Creek attracts thousands of menhaden, a commercially important fish.

On January 28, 1972, the Jersey Central Power and Light plant shut down its nuclear reactors. But pumps continued to force the water from Forked River into Oyster Creek. The sudden infusion of cold water from the Forked River dropped the water temperature in Oyster Creek approximately 13 degrees in 24 hours. Shortly thereafter, more than half a million menhaden fish were found dead in Oyster Creek. Death was attributed to the thermal shock caused by the sudden drop in water temperature. The New Jersey Department of Environmental Protection brought suit against the Jersey Central Power and Light claiming violation of N.J.S.A. 23: 5-28.

This statute, in part, states: "No person shall put or place into. . . any of the fresh or tidal waters of this state any petroleum products, debris, hazardous, deleterious, destructive, or poisonous substances of any kind. . . In case of pollution of said waters by any substances injurious to fish, birds, or mammals, it shall not be necessary to show that the substances have actually caused the death of any of these organisms.

Prepare the class for a mock trial.

The teacher decides the total number of players who will be involved in the mock trial. A judge(s), plaintiff, defendant, plaintiff's attorney, and defendant's attorney will be needed. The teacher assigns roles. Additional witnesses may be called, some of whom can supply scientific testimony regarding tidewater ecosystems, the operation of nuclear reactors, and the laws of thermodynamics. Perhaps other roles, such as a bailiff, a clerk of the court, and a court reporter, might also be useful, and, of course, the jury.

Provide for the airing of opposing views, the introduction of supporting evidence, time for the jury to reach a decision, and time for the judge(s) to determine a sentence.

ACTIVITY

Step 1

Determine the cast and have the cast develop a position for each side.

Step 2

Review trial procedures, making certain everyone understands his/her role and responsibilities.

Step 3

The trial takes place.

Step 4

Once the mock trial has run its course, the stage is set for the debriefing session. Debriefing permits participants to drop out of their roles and look objectively at the development of the two opposing positions. The teacher needs to guide the debriefing with key questions, such as:

Q: What basic issue was in dispute?
Q: What position was taken by the plaintiff?
Q: What evidence supported the plaintiff's view?
Q: What position was taken by the defendant?
Q: What evidence supported the defendant's case?
Q: What did the plaintiff's attorney do to present the plaintiff's evidence in the best light and to raise questions about the defendant's evidence?
Q: What did the defendant's attorney do to present the defendant's evidence in the best light and to raise questions about the plaintiff's evidence?
Q: (To the jury) Tell us the line of thinking you used in arriving at your decision. What would it have taken for you to change your mind?
Q: (To the judge) What line of reasoning did you use to arrive at your decision?

FOLLOW-UP

After the debriefing session, you can compare the outcome of the mock trial with the outcome of the real case upon which it was based. In the actual case, the New Jersey Court of Appeals:

- Found the company to be in violation of the statute. A $6,000 fine imposed by a lower court was upheld, as was an award to the state of $935 in compensatory damages (to pay for the fish that were killed).
- Rejected the company's contention that since the statute in question did not specifically mention thermal pollution, no violation occurred. Court interpreted legislative intent to include any substance that would be "hazardous, deleterious, or poisonous to life."
- Rejected the company's claim that "due process" was violated, since sometimes hot or cold water might not be a hazard and the

continued

> company could not know in advance whether its actions would be construed as a violation. Court stated that the company knew that heated water had attracted menhaden and that a drop in temperature might be harmful. It also admitted that they knew that continuing to run the pumps would result in a sharp drop in the temperature of Oyster Creek; and rejected company's claim that action had resulted from an "unavoidable necessity." Court pointed out that the company's own representative had testified that cooling pumps could have been turned off when reactors were shut down.

As a concluding activity, the teacher might wish to ask such questions as:

Q: What similarities are there between our decision and the court's
Q: What differences are there between our decision and the court's
Q: How might we account for those differences?

Adapted from "Thermal Pollution: Background Material for a Mock Trial," ***Law in American Society***

HARD CHOICES

DESCRIPTION

Students simulate an Environmental Protection Agency hearing on the use of DDT on the spruce budworm.

OBJECTIVE

E-2. To develop understanding that environmental laws reflect a great many factors, such as economic consequences to an industry, technological development, and short- and long-term consequences for the environment.

PURPOSE

To illustrate the compromises and trade-offs necessary in implementing environmental laws.

Time Introduction: 30 minutes Activity: 45 minutes	**Where** Classroom
Topics Environmental regulation, insects, forests	**Materials** 1 copy of the hypothetical situation per student (see below) DDT resource materials (see below for list of where to write)

LEAD-UP/PREPARATION

Collect resource materials for the students to use. The following are some possibilities:

- Rudd, Robert L., *Pesticides and the Living Landscape* (Madison, Wisconsin: University of Wisconsin Press, 1966) pp. 106-109. The original research was reported by Crowter, R.A., and E.H. Vernon, "Effects of Black-Headed Budworm Control on Salmon and Trout in British Columbia," *Canadian Fish Culture* No. 24:23-40 (1959); Keenleyside, M.H. "Effects of Spruce Budworm Control on Salmon and Other Fishes in New Brunswick," *Canadian Fish Culture* No. 24:17-21 (1959); Kerwill, C.J., "Effects of DDT Spraying in New Brunswick on Future Runs of Adult Salmon," *Atlantic Advocate,* Vol. 48, No. 8, pp.65-68 (1958).

- Edwards, J.G., "One Step Beyond: An Inquiry into Research on DDT." Available from the Terra Society, P.O. Box 110, Mt. Prospect, Illinois 60056. Hinckley Ad.D., "The Gypsy Moth," *Environment,* Vol. 13, No. 6 (July/August 1971), pp. 2-9.
- McCaull, Julian, "Questions for an Old Friend," *Environment,* Vol. 13, No. 6 (July/August 1972), pp. 2-9.
- McIntire, Greg, "Spoiled by Success," *Environment,* Vol. 14, No. 6, (July/August 1972), pp. 14-29.

Pamphlets

U.S. Forest Service, "Major Outbreaks of Douglas Fir Tussock Moth in Oregon and California," (Portland, Oregon: Pacific Northwest Forest and Range Experiment Station, 1973) General Technical Report PNW-5.

U.S. Forest Service, "Surveillance Report 1965 Burns Project Douglas Fir Tussock Moth Control," (Washington: G.P.O., 1968) S/N 994-184.

ACTIVITY

Step 1

Hand out copies of material describing the hypothetical situation below. Ask students to read it and respond to it.

"Those insects have to be stopped before they destroy our entire forest," Bob Wilcox, president of the Freight Lumber Company, said. "They are killing nearly all of the trees and if we don't spray them soon with DDT, our company will be without a continuing lumber supply—and that means the mill will close, people will be out of work, and lumber prices will go way up."

"I agree that you've got a problem," responded Chuck Davis, owner of Oldtown's largest salmon cannery. "But you can't use DDT. A few years back, they used it up in New Brunswick on spruce budworm, the same bugs we've got, and it cut their annual salmon run down to about one-sixth of what it had been. If that happens here, my company would be wiped out—and so would all the jobs on the fishing boats."

"But DDT is the only pesticide that will do a quick and thorough job on those budworms," Wilcox argued. "I don't want to destroy your operation and kill all those fish, but I've got my own company, and all those trees to consider. If I don't spray I'll be ruined."

Step 2

After students are familiar with the situation described, divide the class into three groups. Ask the first group to advocate the use of DDT; the second to oppose its use; and the third to represent the United States Environmental Protection Agency. The first two groups should research and prepare testimony to be heard by the EPA panel. The panel will be asked to decide whether the situation warrants issuing an emergency exemption for the use of DDT, in accordance with the 1972 regulations banning the chemical. Students preparing for the "hearing" should consider:

- The economic implications and long-range environmental impact of granting or not granting the permit.
- Alternatives or compromise solutions to the problem.
- The EPA criteria which must be met before the use exemption can be approved. (Students role-playing the EPA should research and establish this criteria, based on the most current information available.)

Step 3

Conduct the hearing and allow the EPA Panel to direct the proceedings. The panel will need some time for deliberation after the hearing before making its decision.

FOLLOW-UP

Ask each student to write an essay agreeing or disagreeing with the panel's decision. S/he should support his/her position, trying to convince the reader of its validity.

Adapted from *Project Learning Tree*

THE NON-PARK

DESCRIPTION

Students predict what would happen to a vacant piece of land in their community that was owned in common by all of the members of the community. They make recommendations for an ideal "commons."

OBJECTIVE

E-3. To understand that the effectiveness of environmental law is dependent on the extent to which individuals and groups accept responsibility for the care of the environment.

PURPOSE

To show that environmental rights, that is, the right to have and hold and use the environment, depends on each individual in our society and on the actions of all of us.

Time 1 hour	**Where** Classroom
Topics Land use, urban environment, human ecology	**Materials** The Premise (see below) 1 per student

LEAD-UP/PREPARATION

Prepare a copy of The Premise for each student.

ACTIVITY

Step 1

Distribute copies of The Premise:

Mr. Ebeneezer Cratchett was the richest and nastiest man in town and everyone disliked him and he disliked everyone. No one remembers a time when this wasn't so. When Mr. Cratchett passed on, he left most of his wealth to relatives who lived far away. There remained only the overgrown, rubble-strewn, muddy mess of an acre called Cratchett's Field, which was situated in the center of town. This he left to the town and to all the people in the town to do with as they wished forever. There were two little instructions for his lawyers to follow, however, which went along with the gift. One instruction read "Tear down the fences so that everyone will have unlimited access to the field," and the other read, "Put up a sign, large and high, which will say, You always get what you deserve."

Step 2

Divide your class into several small groups. Each group has the assignment of completing the story of Cratchett's Field. In its stories, each group should answer the following questions:

- What did Cratchett have in mind by requiring that everyone have unlimited access to the field?
- What did the sign mean?
- What was the area like after ten years?

Step 3

Have the stories shared with the class. Discuss the outcomes predicted by the groups. How many were pessimistic; that is, saw bad outcomes or no improvement as probable? How many saw the town government as a major factor in the success or failure of the field as a public place with good outcomes? How many called for large amounts of money for complex projects? How many called for ecological solutions? How many called for the creation of committees and groups? How many saw individual action as being important?

FOLLOW-UP

1. Have your students make up stories about other "gifts" and their consequences. For example, gifts such as oil discovered on your farm, a new highway through town, or a new plant in the valley.
2. Individuality is often considered an American trait, and we look upon it with some pride. Many of our greatest achievements as a people were spurred on by individuals of great talent and foresight. Have each student select a favorite person(s) of individual strength and achievement and write a paper on that person. Some suggestions:
    - John Muir
    - Rachel Carson
    - Ralph Nader
    - Jane Goodall
    - J. P. Morgan
    - Andrew Carnegie
    - John A. Sutter
    - Buckminster Fuller
3. Have students describe or draw their ideal "commons" of one acre.

Energy and Environmental Resource Management Activities

ENERGY AND ENVIRONMENTAL RESOURCE MANAGEMENT

Issues

The ultimate goal of resource management in the present-day context is to increase the productivity of our environment to meet the needs of an expanding population. On the underside of that optimistic outlook there is another equally urgent goal to ensure our survival. One concept emphasized in the section of the Natural Environment is the importance of habitat for the survival of any species of wildlife. In this section, that concept is applied to the human race and particularly to those of us who share in that part of the planet called California.

We are all familiar with the type of resource management that results in building a dam to provide for a continuous flow of water to an urban area, or a public works canal that carries water to farmlands for irrigation. And most of us have experienced the need to conserve water or gasoline when there are shortages. But after the dam was built, we discovered that fish no longer came up the rivers to spawn, and when the farmlands were irrigated, we discovered that salinization due to poor drainage was reducing the productivity of the land. One attempt to control the environment and manage a single resource led to other problems and the need for managing other resources. When the water or gasoline shortage abated, we knew we were still vulnerable and our lifestyles could be affected almost any time by another scarcity. Along the path of these experiences, the meaning of resource management has changed from a one-problem approach to a holistic outlook and a tacit recognition that humans are, in fact, only members of a biotic team.

A holistic approach to resource management is based on the recognition of at least two realities about our environment. One is that the environment is infinitely complex and any system for managing its resources must take into account all the ramifications that ensue from any intervention into its operation. Another is that we are confronted with the reality that we are approaching the economic limits of nonrenewable resources such as oil and gas. We face the challenge of finding a new basis for continued prosperity and a satisfactory quality of life. The answer lies in an increased reliance on and caring for renewable resources, such as forests, fisheries, farm soils, and rangelands. Underlying this shift in emphasis is another recognition that our natural resources constitute our true wealth now and for future generations.

Four concepts have been defined for developing students' understanding of resource management. The first is concerned with conservation, one way in which the real supply of resources can be increased by consuming less. The second is concerned with renewing resources, the problems involved in establishing continuously renewing supplies of resources. The third is concerned with understanding past — and present-day models for resource management and the lifestyles that include this as part of everyday living. The fourth is a description of the model for resource management that is being developed in California through the state government. A selected number of resource management departments are described in terms of the long-range problems with which they are dealing. Their particular departments were selected because their long-range planning needs so clearly exemplify the range of environmental problems which our society, in general, is confronting. Other departments within the Resource Agencies are also described more briefly and a number of educational materials that are available from each agency are listed and described. Detachable, addressed postcards for ordering materials or requesting information from each department accompany the materials list.

ENERGY AND ENVIRONMENTAL RESOURCE MANAGEMENT

MAJOR CONCEPTS	OBJECTIVES
A. There are a number of historic and present-day models which can be used in developing resource management programs.	1. To understand how groups of people historically have managed scarce natural resources for their collective benefit. 2. To be aware of the key factors in the world today that have contributed to the decreased availability and quality of all natural resources.
B. Conservation is the most immediate way of increasing the real supplies of a natural resource. Conservation practices focus on more efficient uses of natural resources.	1. To be aware of the importance of non-renewable resources for maintaining our lifestyles. 2. To be aware of economic, legislative, social, and other means that can be used in promoting the conservation of resources. 3. To become aware of the potential for recycling and reclaiming resources.
C. Some resources are renewable and can be maintained so they will provide consistent and continuous supplies of resources as they are needed.	1. To be aware of the role of technology in renewing and recycling resources. 2. To understand that through technology, we expand the range of resources which we use in meeting our needs and desires. 3. To be aware of the complexity which often exists in resource management, especially when intergovernmental and intercorporational cooperation is required. 4. To understand the necessity of long-range planning for resource management in relation to the assessment of future needs.
D. Resource agencies and their departments maintain the productivity of our natural resources into the future.	See California State Resource Agencies section.

ENERGY AND ENVIRONMENTAL RESOURCE MANAGEMENT OBJECTIVES & ACTIVITIES

		K-3	4-6	7-9	10-12
CONCEPT A	1. To understand how groups of people historically have managed scarce natural resources for their collective benefit.	The teacher gathers and brings to class natural materials used by California Native Americans.	Students participate in a decision-making simulation game taking place on a wagon train.	Students are presented with situation cards describing a lifestyle from the past and present expectations for the future.	Students describe their attitudes toward natural resources from the viewpoint of persons in the distant past.
	2. To be aware of the key factors in the world today that have contributed to the decreased availability and quality of all natural resources.	Students simulate the effects of population growth.	Students monitor TV commercials and discuss how consumption patterns have changed over time.	Students study maps of an imagined wetland island. They note changes over time, and make recommendations for the development of the island along more environmentally sound lines.	Students research the changes which have occurred in local commute patterns since World War II.
CONCEPT B	1. To be aware of the importance of nonrenewable resources for maintaining our lifestyles.	Students monitor their classroom water use and take action to reduce water use.	Students conduct an energy audit of their classroom and discuss energy waste.	Students take a look at the air pollution problems of Los Angeles and determine ways in which Angelenos might improve the situation.	Students learn to read electric and gas meters. They do an energy audit of their homes.
	2. To be aware of economic, legislative, social, and other means that can be used in promoting the conservation of resources.		Students conduct a survey to assess attitudes and incentives related to recycling.	Students examine the bill which made the 55 miles per hour speed limit the law, its hows and whys.	Students state their opinions on the many "ways" to save a tree and rank them on effectiveness and desirability.
	3. To become aware of the potential for recycling and reclaiming resources.	Students make paper from used paper, cardboard and other materials.	Students choose a household container and research how it was made and what happens when it is "thrown away."	Students put together a picnic lunch with the minimum amount of unrecyclable materials, a "garbage free" lunch.	Students take a fact-finding trip to a local recycling center and interview the persons involved in the recycling effort.
CONCEPT C	1. To be aware of the role of technology in renewing and recycling resources.	Students take a short field trip to a Christmas tree farm or sales lot. Students make decisions about Christmas trees.	Students visit a lumberyard and interview a lumberyard worker.	Students make musical instruments out of forest materials.	Students learn how agriculture alters the biosphere and how much land surface has been altered by human activity.
	2. To understand that through technology, we expand the range of resources which we use in meeting our needs and desires.	Students examine their shoes, consider how shoes are made, and identify the variety of materials used.	Students take a survey of things at school, how these things got there and the fuel used for moving these.	Students learn rudiments of road map reading and discuss transportation in California, past and present.	Students design environmental, energy and resource management games requiring technological solutions.
	3. To be aware of the complexity that often exists in resource management, especially when intergovernmental and intercorporational cooperation is required.	Students plan and manage a classroom garden.	Students are each given control over one major resource. They negotiate with other students to get needed resources.	Students research episodes of California history concerned with resource management, such as The Great San Francisco Egg War.	Students discuss a hypothetical situation showing the trade-offs necessary to, and common in, resource management.
	4. To understand the necessity of long-range planning for resource management in relation to the assessment of future needs.		Students compare their "lifespans" to the "lifespans" of selected resources.	Students design a community emphasizing the relationship between the work place and the residence.	Students organize an expedition walking trip of 200 hundred miles (320 km) or more, using a systems approach to planning and problem solving.
CONCEPT D	See California State Resource Agencies section.				

RESOURCE CONSUMPTION, PAST - PRESENT - FUTURE

DESCRIPTION

Students are presented with situation cards describing a lifestyle from the past and present expectations for the future. They compare and contrast material wealth and the use of resources to provide those materials.

OBJECTIVE

A-1. To understand how groups of people historically have managed scarce natural resources for their collective benefit.

PURPOSE

To show that society has had different systems for the management and exploitation of the resources available to it through time.

Time 1-2 hours	**Where** Classroom
Topics Cultural history, environmental values, technology	**Materials** Situation cards (see below)

LEAD-UP/PREPARATION

Prepare copies of the two situation cards for distribution to the class.

Situation Card 1: Looking ahead into the future, what kind of place would you like to live in as an adult? List those things you would like to have as an adult.

Situation Card 2: You are the same age you are now, but you were born in 1866. The Civil War has just ended. The main means of transportation are by foot, by rail, and by horse. Most people are engaged in farming and most people live in the country rather than in the city. Only a few young people go to college; most make a living by farming or entering one of the trades (plumbing, construction, blacksmithing, etc.). Electricity has only been recently "discovered," and most homes have kerosene lamps, a hand pump for water, and an outhouse. Vegetable gardens are common. You have no indication that cars or electricity will ever be available or useful in the home or for work. On this basis, list the things you would like to have as an adult in your home of the 1980's or '90's.

ACTIVITY

Step 1

Divide the class in half. Give half situation card 1 and the other half situation card 2.

Step 2

Ask all class members to write a paragraph or two about their adult lives on the basis of information provided on the cards, and to list those things they would like to have as adults in their situations (a carriage, a car, a farm, a professional business, etc.).

Step 3

Have the students describe the lifestyles they would lead in their situation and name the things they might own.

Step 4

List the things they might own on the chalkboard, making one list for the "modern-day" students and another list for the 19th century students.

Step 5

Q: Comparing items from the two lists, which set of possessions require more resources to manufacture them?

Q: Why do the modern possessions require more resources than those manufactured in the 1800's?

Q: Judging from the items on the two lists, how has resource consumption changed over the last 100 years?

Q: What factors have brought about this change?

Q: How have prices changed for resources used now and for the same resources used 100 years ago?

Q: What factors have brought about this change?

Q: Judging from these patterns of change, what can you predict about resource use and resource prices in the next 100 years?
Q: What can be done to alter this?
Q: How many children would you like to have? (Total these for the entire class.)
Q: How will all these new people affect the future pattern of resource use and price?
Q: How does advertising affect consumer demand for products and resource usage?
Q: Do advertisers show a concern for resource usage? How? Why or why not?

FOLLOW-UP

Write situation cards comparing the modern United States with a Third World nation. Compare expectations of the citizens of these two cultures.

Adapted from *Environmental Education Activities Manual.*

HOW A WETLAND HAS BEEN CHANGED

DESCRIPTION

Students study a map of an imagined wetland island. They note changes over time and make recommendations for the development of the island along more environmentally sound lines.

OBJECTIVE

A-2. To be aware of the key factors in the world today that have contributed to the decreased availability and quality of all natural resources.

PURPOSE

To show how resource consumption has changed in recent years and to show the effects of accelerating change on the environment.

Time	**Where**
1-2 hours	Classroom
Topics	**Materials**
Estuaries and wetlands, human ecology	Copies of maps for each student (included)

LEAD-UP/PREPARATION

Prepare copies of the four maps of Delta Island for each student.

ACTIVITY

Step 1

Examine all four maps. Ask the questions below:

1. Look at the first map. What percentage of Delta Island was covered by marsh?
2. Look carefully at the development that has taken place at each ten year interval. In each case, how has transportation increased? What industries have been added or expanded? How has the residential development increased? What recreational facilities have been added? What public services have been added to meet the needs of the residential and industrial development?

continued

3. What percentage of the marsh was filled in at each ten year interval?
4. Compare Map 1 with Map 4. What is the percentage of the original marsh that remains?
5. What was built first that stimulated the rest of the development?
6. What has been the effect of this development on the wetlands and the animals living and breeding there?
7. How has the fishing been affected by the increase in development?
8. In what ways could people use the marsh in its natural state for recreation? In what ways have people altered the marsh for recreational purposes? How have the recreational uses of the island changed over time?
9. What immediate benefits are received by development of the wetlands? What are the long-term benefits of this development? Who has been adversely affected by the development of the wetlands?
10. Where could development have taken place on this island without destroying the marsh vegetation?

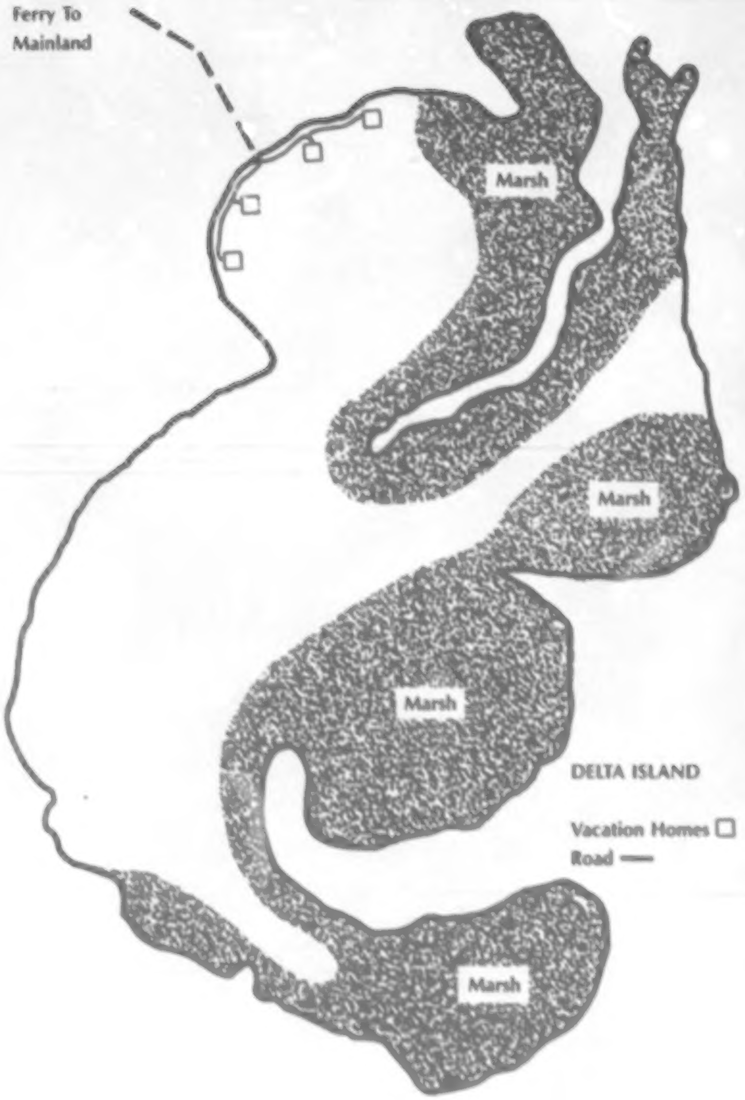
Step 2

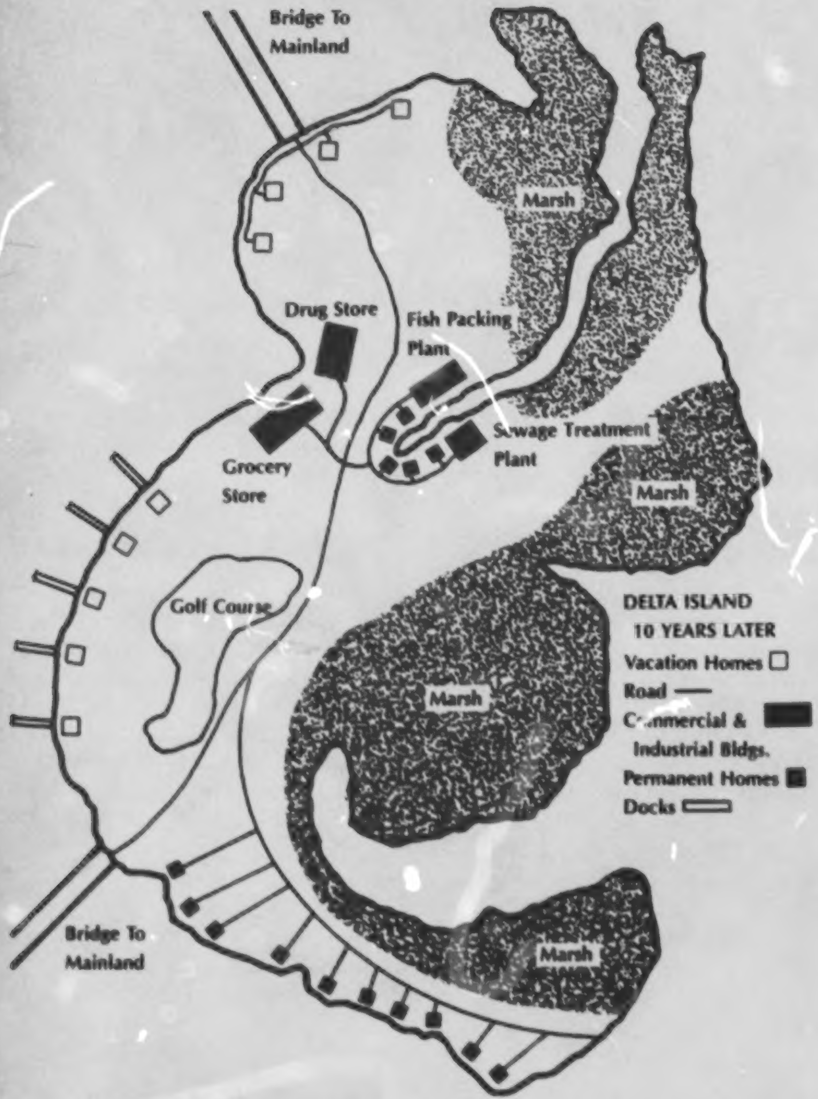
Now that your students have examined what human development can do, they are ready to develop their own plans for the island using the first map as a guide. The individual plans created by the students should provide for human needs without completely destroying the marsh. They must consider the economic needs of the population and still provide the best balance between development and conservation of the marsh.

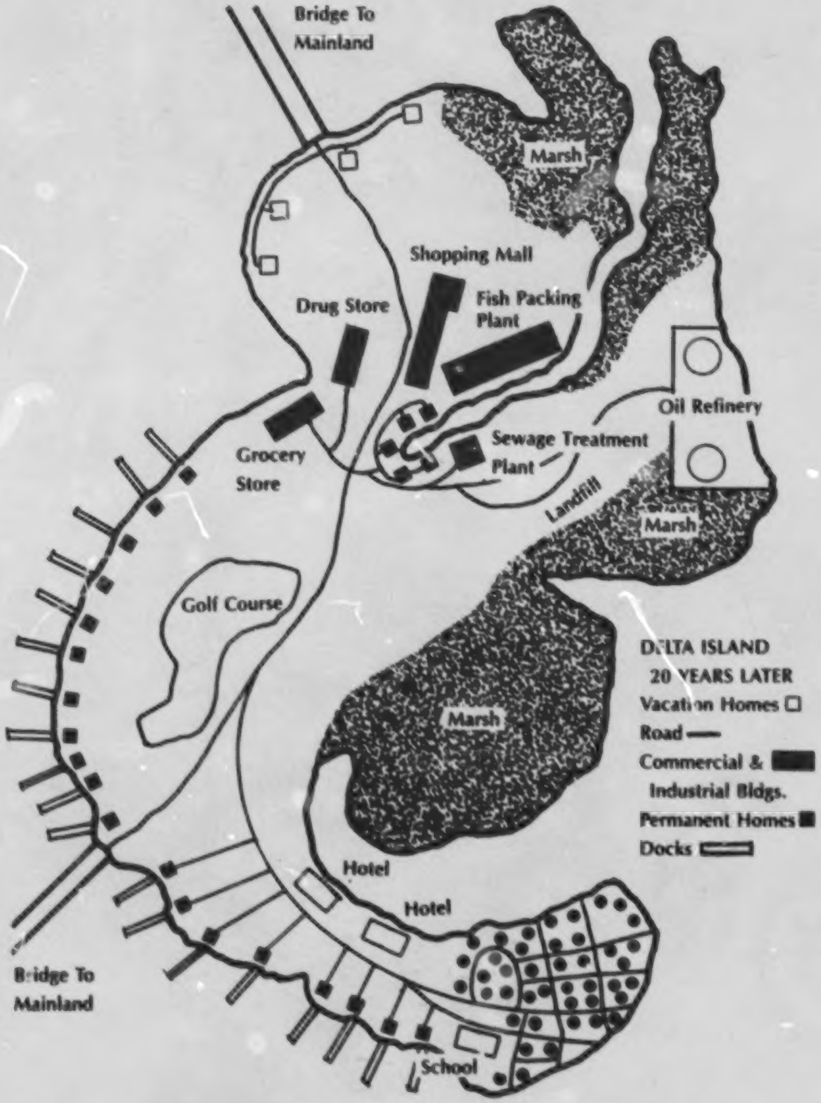
FOLLOW-UP

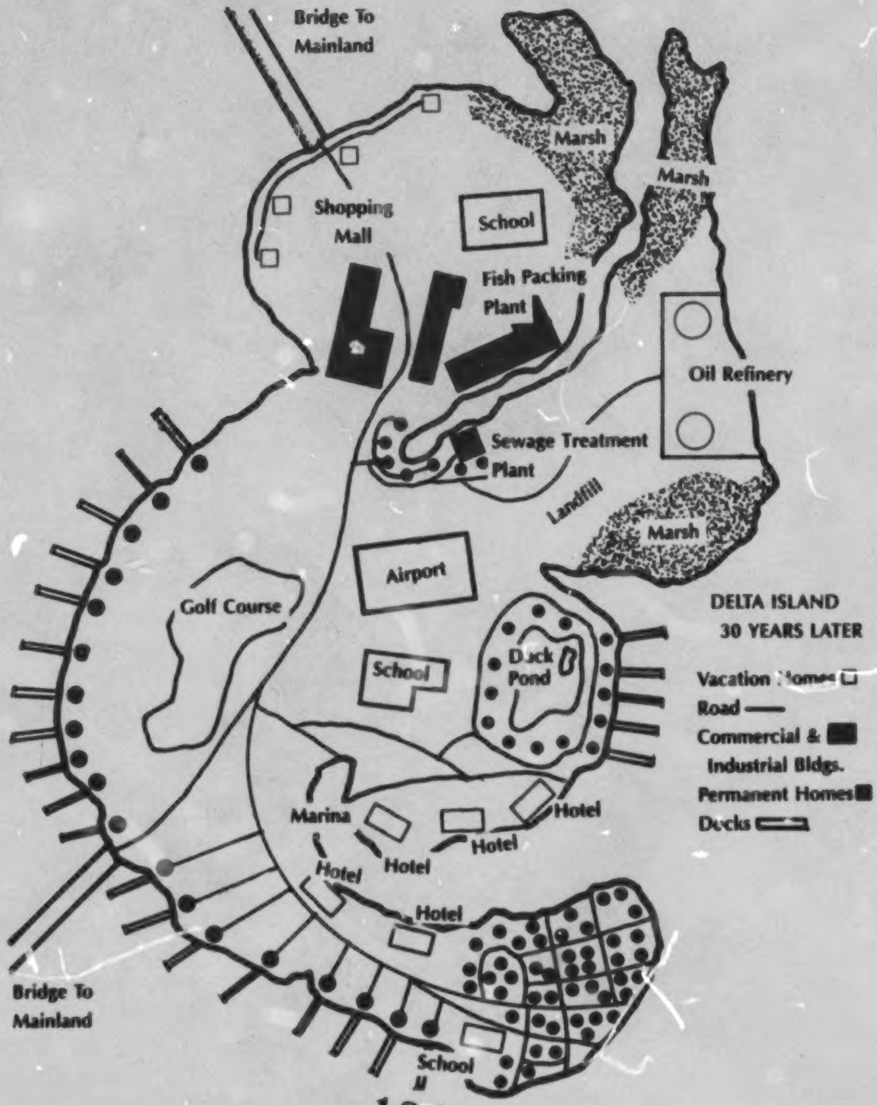
1. Find a local wetland in danger of development. Will such a development be beneficial or harmful? To whom?
2. Plan a campaign to influence the outcome of a local wetlands issue.

Adapted from National Wildlife Federation materials.




Bridge To Mainland
Marsh
Drug Store
Fish Packing Plant
Sewage Treatment Plant
Grocery Store
Marsh
Golf Course
Marsh
Marsh
Bridge To Mainland
DELTA ISLAND
10 YEARS LATER
Vacation Homes □
Road —
Commercial & Industrial Bldgs. ▬
Permanent Homes ■
Docks ▭


Bridge To Mainland
Marsh
Shopping Mall
Drug Store
Fish Packing Plant
Oil Refinery
Grocery Store
Sewage Treatment Plant
Landfill
Marsh
Golf Course
Marsh
Hotel
Hotel
School
Bridge To Mainland
DELTA ISLAND
20 YEARS LATER
Vacation Homes □
Road —
Commercial & Industrial Bldgs. ▬
Permanent Homes ■
Docks ▭


Bridge To Mainland
Marsh
Marsh
Shopping Mall
School
Fish Packing Plant
Oil Refinery
Sewage Treatment Plant
Landfill
Marsh
Airport
Golf Course
School
Duck Pond
DELTA ISLAND
30 YEARS LATER
Vacation Homes ☐
Road —
Commercial & Industrial Bldgs. ■
Permanent Homes ■
Docks ⊏⊐
Marina
Hotel
Hotel
Hotel
Hotel
Hotel
Hotel
School II
Bridge To Mainland

IN GOES THE GOOD AIR . . .

DESCRIPTION

Students take a look at the air pollution problems of Los Angeles and determine ways in which they (if they were Angelenos) could improve the situation. Air pollution in Los Angeles is seen as a function of population, geography, and other factors.

OBJECTIVE

B-1. To be aware of the importance of nonrenewable resources for maintaining our lifestyles.

PURPOSE

To examine an effect of industrial waste coupled with over-population.

Time	**Where**
30 minutes	Classroom
Topics	**Materials**
Air pollution, urban environment, transportation	For every 4 students: road maps of Los Angeles or sketch maps of the Los Angeles basin

LEAD-UP/PREPARATION

Discuss the following concepts with the class as background information on the Los Angeles air pollution situation. Maps of Los Angeles should be provided.

- Los Angeles is a contained air basin.
- Pollutants trapped by inversions result in poor air quality.
- Air quality affects people differently. People develop adapting mechanisms to cope with dirty air.
- Few people know what the daily health warnings mean.
- Define: photochemical smog, inversion, oxidant, particulate smog.

ACTIVITY

Step 1

Have your students answer the following questions as if they lived in Los Angeles. Then have them answer again with respect to air quality in their own community.

Q: List the ways you personally determine air quality. Is visibility of certain landmarks one criterion? Which landmarks do you look for to see how dirty the air is?

Q: Based on air quality, where in the Los Angeles basin would you prefer to live? Near the beach? Downtown? Towards San Bernardino?

Q: Do you ever curtail your activities due to air quality warnings on the radio? Why or why not?

Step 2

Have your students approximate the number of miles per day they drive or are driven. (The average Angeleno drives 30 miles per day.) As an Angeleno, could you cut this by 25 percent? By 50 percent? How? Have your students brainstorm possible solutions (walking, changing jobs, moving closer to the job, using mail more, using public transport, and actively promoting more effective mass transit, bicycles, etc.).

FOLLOW-UP

1. Discuss. Pointing the finger of blame is an easy thing to do. What would be the social and political results of a sophisticated system for pinpointing and identifying all air pollution sources? (What would happen if everyone knew exactly who was polluting the air?) What would happen if no new polluting industries were allowed to locate in Los Angeles?
2. Discuss the absolute banning of the automobile from the Los Angeles basin.

Adapted from *Scoring Los Angeles Landscapes*

55 M.P.H. . . . IT'S THE LAW

DESCRIPTION

Students examine the bill which made the 55 m.p.h. speed limit the law and examine how and why it was enacted and is enforced by the states.

OBJECTIVE

B-2. To be aware of economic, legislative, social, and other means that can be used in promoting the conservation of resources.

PURPOSE

To show that conservation of resources may be promoted through legislation.

Time 1 hour plus homework	**Where** Classroom plus interview
Topics Environmental legislation, human ecology, technology	**Materials** Copies of PL 93-643 (see below)

LEAD-UP/PREPARATION

Prepare a copy of Public Law 93-643 for each student.

ACTIVITY

Step 1

Distribute copies of PL 93-643. Read it aloud, paraphrasing where necessary.

Step 2

Have your students answer the following questions:

Q: What year was this law made? (1974)

Q: Which Department of the Executive Branch is responsible for seeing that the law is obeyed? (Transportation Department)

Q: What can the Secretary of Transportation do if the law is not enforced by the states? (suspend highway funds)

continued

Q: Does the law spell out why the speed limit of 55 m.p.h. was wanted? (no)
Q: Was there a national speed limit before this law was passed? (no)
Q: What does each state have to do before January 1 so that its highway building funds are not cut off? (certify that it is enforcing the 55 m.p.h. speed limit)
Q: According to Section 154, is it okay to have a speed limit less than 55 m.p.h.? (yes)

PUBLIC LAW 93-643

"Be it enacted by Senate and House of Representatives of the United States of America in Congress assembled, that this Act may be cited as the Federal-Aid Highway Amendments of 1974."

154. National Maximum Speed Limit

(a) the Secretary of Transportation shall not approve any (highway) project . . . in any state which has . . . a maximum speed limit on any public highway within its jurisdiction in excess of 55 miles per hour.

141. Enforcement

Each state shall certify to the Secretary (of Transportation) before January 1 of each year that it is enforcing all state laws respecting . . . all speed limits on public highways in accordance with Section 154 (national maximum speed limits) . . .The Secretary shall not approve any (highway) project . . . in any state which has failed to certify in accordance with this section."

Step 3

Have your students interview an older person who remembers the energy situation of 1974. Ask them to find out some background information about the 55 m.p.h. limit. They may ask, for example: what was the highway speed limit before the 55 m.p.h. law was passed? What were the reasons why the federal government wanted cars and trucks to slow down? (OPEC oil boycott, crunch at the pumps, United States importing too much of its oil, 55 m.p.h. conserves fuel when compared to higher highway speeds and is safer than higher speeds.)

FOLLOW-UP

1. Have your students invite a representative of the California Highway Patrol to visit your class. Have the officer relate his/her experiences with respect to the 55 m.p.h. speed limit.
2. Have your students read Amendments 9 and 10 to the federal Constitution (last two numbers of the Bill of Rights). Discuss: What right does the federal government have to order the states to enforce a federal law such as PL 93-643?

RECYCLE YOUR PICNIC

DESCRIPTION

Students put together a picnic lunch requiring the minimum amount of unrecyclable materials to be used, a "garbage free" (or almost) lunch. Students plan for the recycling of paper, glass, and metals used.

OBJECTIVE

B-3. To become aware of the potential for recycling and reclaiming resources.

PURPOSE

To familiarize students with the potential recyclability of materials and resources.

Time	**Where**
2 hours including lunch period	Classroom and park on picnic field trip
Topics	**Materials**
Recycling, food	Student lunches

LEAD-UP/PREPARATION

Hold a class discussion. Ask the following questions:

Q: Where does garbage come from? Where does it go?

Q: Land fills and dumps are called "Mt. Trashmores." What are the bad features of such dumps? Do dumps have any good features? What will happen when our community runs out of landfill space?

If possible, arrange for a lunch picnic to a nearby park.

ACTIVITY

Step 1

Ask the students to try and prepare a garbageless lunch for your picnic (or for tomorrow's lunch at school).

Ask the students to package their lunches for their trip using as little paper or plastic as possible. Try and create a "no-garbage" lunch.

Step 2

After their field trip lunch, instruct the students to keep all their leftover lunch foods and packaging materials together for a recycling lesson. After a bit of free time, gather your group in a circle.

Step 3

At some point, hold up a used wrapper and ask: "Well, what shall we do with this?" and someone will say, "Just throw it away!" "Oh, where's away? Is there such a place? Does something absolutely disappear? Be conscious of where you put things! Everything has to go somewhere!"

Step 4

Q: Help students clarify their concepts of recycling.

Q: What things are you recycling?

Q: Do you throw your shirt in the garbage when it becomes dirty? No, we reuse it. Compare paper towels and cloth towels.

Q: Which habits waste more resources?

Q: What are items we recycle in our lives?

Step 5

Collect all the food leftovers from your lunches into one pile. Weigh it. Now ask what we might do with our leftovers.

Q: How can we turn this banana peel into a football? (feed it to the pigs)

Q: How can we turn this orange peel into a strawberry? (compost pile used later to fertilize strawberry plants)

Step 6

Packaging—some alternatives:

Sort out items that can be taken to a recycling center. Count the number of wrappers used.

Q: Who used the fewest? Tape the pieces together into a long banner and hang it in your classroom. A week later, compare your consumption habits with another lunch.

Q: Has anything changed?

Gather in a circle and have students select different types of packaging (paper bag, plastic bag, plastic dishes).

continued

Discuss:

Q: Where does the wrapper come from? What is it made of? How far was it transported.

Q: How many times have you used this packaging? Do you expect to use it in the future?

Q: Does use of this packaging resource require large, medium, or small amounts of energy? Money? Resources?

Q: Which items are durable? Reusable? Recyclable? Which packaging may use the least energy?

Ask each student to find an item in the lunch that s/he can use again. Fold that paper bag up neatly!

FOLLOW-UP

Plan a field trip to a recycling center. Let the center know you're coming for a tour. Bring materials to recycle. Send class questions in advance to the people who operate the center.

Adapted from *Manure to Meadow to Milkshake*

MUSING ON MUSIC

DESCRIPTION

Students make musical instruments out of forest materials.

OBJECTIVE

C-1. To be aware of the role of technology in renewing and recycling resources.

PURPOSE

To show that with ingenuity many products and materials can be seen to have other uses. Many materials are renewable both at the source and by the consumer.

Time	**Where**
1 hour	Classroom
Topics	**Materials**
Renewable resources, aesthetics, technology	Many and varied—can be scrounged

LEAD-UP/PREPARATION

Discuss the four major groups of musical instruments—strings, woodwinds, brass, and percussion. Show pictures of musical instruments and ask your students to group them. Ask the students about the "hybrid" instruments, particularly the piano which is a string-percussion instrument. To which group of instruments is the human voice most closely related?

ACTIVITY

Step 1

You and your students can create musical instruments out of wood and other forest-derived materials. The materials might have been used before, or not be in their original state; for example, cardboard sheets and twine can be used to make a stringed instrument; cardboard tubing from rolls of paper towels can be used to make a flute-like instrument; wooden blocks can be used to make a percussion instrument; and cellophane can be stretched over a cylindrical ice cream container and brushed with straw to make a delicate drum. Try to make a variety of instruments, including some strings, woodwinds, and percussions.

Step 2

Have a concert and play the instruments in class.

FOLLOW-UP

1. Imagine groups of people throughout history who might have created instruments like these. Create stories to explain the significance of each of the instruments with imaginary cultures.
2. Trace the history of any musical instrument through to its cultural roots. If the students can identify actual musical instruments similar to those they created, they might trace one or more of these back to its origins. Find out where the first versions of the instrument were developed, what plant or tree materials were used, what kinds of music for what purposes were played using the instruments. Create ways to communicate this history musically, visually, and verbally.
3. Locate examples of instruments developed by a certain culture. Students might wish to learn to play them. They might find or compose musical pieces that reflect some important aspect of the culture's history.
4. Bring to class recordings of different musical instruments being played. Ask the students to create paintings, line drawings, or murals of what comes to mind as they listen to the recordings.

Adapted from *Project Learning Tree*

POINT A TO POINT B, THEN AND NOW

DESCRIPTION

Students learn the rudiments of road map reading and discuss transportation in California in the past and present.

OBJECTIVE

C-2. To understand that through technology, we expand the range of resources which we use in meeting our needs and desires.

PURPOSE

To show that through technology the range of resources available to meet our needs has been expanded.

Time	**Where**
1-2 hours plus homework	Classroom
Topics	**Materials**
Transportation, environmental values, cultural history, population	California road maps, one for every 3 students

LEAD-UP/PREPARATION

Obtain copies of oil company or California State Automobile Association road maps for the State of California. Up to three students can share one map. Distribute the maps to your small groups. Assign the following tasks to each group. (You may want to prepare this as a game, the first group finished winning a small prize.) When most of the class is finished, go over the answers in detail.

TASKS

1. Draw and label an arrow in the Pacific Ocean pointing north. Also show which direction is east, west, and south.
2. Draw a line in the ocean which represents 100 miles and another which represents 100 km.
3. Locate San Francisco, Los Angeles, Eureka, Bakersfield, Needles,

continued

Lake Tahoe, Asilomar State Beach (end of the Monterey Peninsula), the westernmost point in the state, Oakland, San Diego.

4. Outline lightly in pencil the Sierra Nevada, the Mojave Desert, the Trinity Alps, the Napa Valley, the Gold Country.

ACTIVITY

Step 1

Have your students trace a road route from Los Angeles to San Francisco. Which of these is shortest in terms of miles? Which is shortest in terms of time: (Routes will include I-5, US 1, US 101, and others.)

Step 2

Have your students write a story describing a trip of 100 miles (160 km) taken 100 years ago, and the same trip taken today.

Step 3

In a class discussion, compare the two trips of then and now.

Q: Which trip was harder? Which was more convenient? Which was more fun to write about? Which would be more fun to take?

Q: Did your old-time trip follow pretty much the same route as a modern trip would?

Q: How did you travel in your old-time trip? By horse? Wagon?

Q: What were the major modes of transportation in California 100 years ago? (Foot, horse, wagon, railroad, boat up the Sacramento River, coasting ships.)

Q: How long does it take to fly from Los Angeles to San Francisco?

FOLLOW-UP

1. Investigate the ways in which the Forty-Niners got to the gold fields from San Francisco and other parts of the state.
2. In the past, a letter from Los Angeles to San Francisco was carried on coasting ships or sent by wagon up the coast. Today most mail between the two cities is sent by plane or by truck. How will most personal and business letters be sent in the future?
3. Have your students write a story of a trip from Los Angeles to San Francisco 100 years from today. (Do they predict positive technological advances or do they predict something else?)

THE GREAT EGG WAR

DESCRIPTION

Students research some of the more colorful episodes of California history which are concerned with "resource management and development." The Great San Francisco Egg War is detailed as an example of one such episode.

OBJECTIVE

C-3. To be aware of the complexity that often exists in resource management, especially when intergovernmental and intercorporational cooperation is required.

PURPOSE

To show that constructive and long-range resource management on a large scale requires extensive cooperation among all sectors of society.

Time	**Where**
2 hours (including homework)	Classroom
Topics	**Materials**
Cultural history, environmental values	None

LEAD-UP/PREPARATION

Read the following account of the Great San Francisco Egg War to your class.

One spring day in 1850 a young prospector dragged himself into the best eating place in Placerville, California, then called Hangtown. As he walked in, tired from his long ride from Angel's Camp, all eyes followed him. In spite of his dusty and fatigued look, he had the air of a man who had just struck it rich in gold. He looked slowly around, then sat down. He said to the waiter, "Sir, I am very rich. I want you to prepare a meal for me consisting of only your most expensive and finest foods." "Yes sir!", replied the owner, delighted at such an order. All of the people in the restaurant waited breathlessly to see what the chef would prepare.

Finally, out it came! The chef uncovered the silver dish and there, sitting garnished and elegant was an oyster omelette. To this day an oyster omelette is called the "Hangtown Fry." Both the eggs and the oysters were gifts from the sea. In the early days of the Gold Rush, the only source of fresh eggs was from nests of sea birds on the Farallon Islands off the coast of San Francisco. Rival companies were formed which would sail to the Farallons to gather eggs from the slippery cliffs of the granite islands. Eggs were selling for several dollars each and the price was rising daily. Eventually, the high price and the diminishing supply of eggs, as well as the danger involved, led to violence. The Great San Francisco Egg War ended only when vigilantes hanged many of the most violent egg traders and when laying hens were finally imported from the East and the Orient.

ACTIVITY

Step 1

Prepare a list of California episodes similar in flavor to the Great San Francisco Egg War. Such a list might include:

- The Exploits of Joaquin Murietta
- The Journeys of Junipero Serra
- The Mormons in the San Bernardino Valley
- The History of Emperor Norton
- The Naming of the Golden Gate by John C. Fremont
- How the Brig *Euphemia* was beached and became the City Jail of San Francisco
- How the Steamboat *Senator* made $50,000 a week between San Francisco and Sacramento
- Mail order brides from France in the Gold Rush

Step 2

Have each student pick one such episode for further study. Reports, drawings, scrapbooks, poems, etc., should stress the resource management aspects of the happening. For example, a report on the Egg War should make the point that the bird eggs were a resource that could have been managed better. Because of poor management, people were killed. Prices soared and eventually there were no more eggs to be had from this source. The bird population was greatly reduced. To this day the Farallon Islands are protected by the government because of its early history of exploitation (eggsploitation).

Step 3

Discuss the following questions with respect to the California episodes reported:

Q: What resources are involved in this story?
Q: What bad practices are shown?
Q: What good practices are shown?
Q: What was the involvement of government to this story? Of private enterprise? Of citizen's groups? Of media?
Q: If these groups had shown more of a spirit of cooperation, what outcomes would have been changed?

FOLLOW-UP

There are some present-day issues which cry out for "sector cooperation" for what might be perceived as proper outcomes. Have your students research one or more of the following with emphasis on cooperation being the first step toward the best solutions:

- The Drying of Mono Lake
- The Overpopulation of Nonpredator Species in Our Parks
- Land Use in the Tahoe Basin
- The Peripheral Canal
- Nuclear Power Plants (Sundesert, Canyon Diablo, Rancho Seco)
- Distribution of Farmlands in Westlands Water District
- Aspirations of Migrant Workers
- Flight of Business from the Inner Cities
- Splitting of California into Two or More States

THE BEST LAID PLANS

DESCRIPTION

Students design a community emphasizing the relationship between the work place and the residence.

OBJECTIVE

C-4. To understand the necessity of long-range planning for resource management in relation to the assessment of future needs.

PURPOSE

To show that long-range planning is an essential activity for effective resource management.

Time 1-2 hours.	**Where** Classroom
Topics Land use planning, human ecology, transportation	**Materials** Butcher paper for small groups; rulers, magic markers, crayons

LEAD-UP/PREPARATION

Discuss the length of time and the distance workers commute in your area. Emphasize the wasted time and energy that commuting creates. Speak of your own or your colleagues' trips to and from work each day.

ACTIVITY

Step 1

Make a list of the businesses and industries for whom the parents of your students work. (This can be a touchy subject for some students. Ask students to volunteer until you have 10-15 responses.)

Step 2

Working with your students in groups or individually, develop a planned community which includes only the places where the students' parents work and the services needed by them. Do not use a map of your community. Let them develop their own community plan, rearranging the businesses, industries, and residential areas as they see fit.

Step 3

When plans are complete, have students exchange plans. Have them analyze the plans:

Q: What services have been provided which would be operated by the local government?

Q: What services have been provided which are privately owned?

Q: Have provisions been made for fire departments? Dentists? Hospitals? Roads? Post offices? Government? Food? Clothing? Are there land uses next to one another which might not be compatible; for example, a large factory and a library?

Step 4

The groups or individuals who have critiqued each other's plans could then work together to revise their plans and develop *one* combined plan.

Step 5

Display all the plans around the classroom and look for similarities and differences among them.

Q: Is there evidence that the overall approach taken by each planner was different?

Q: What problems arose in developing the plan?

FOLLOW-UP

Investigate modern planned cities such as Reston, Virginia. Is life "better" in such places? If you think so, in what ways is it better?

Some large cities were at one time planned to make life better there. Some examples are Washington, D.C.; Brasilia, the capital of Brazil; and Paris, France. Have students research the history of these planned cities. What is life like in these places? Is it better or worse because the city was planned? Do people live closer to their jobs in planned cities?

Visit your local planning board or zoning board offices. Arrange in advance for a speaker to show your class the operations of the agency, and to assess how successful they have been in providing for a safer life, and for a higher quality of life in your community through long-range planning.

What is the potential of the ocean area for future jobs? What zoning concepts would be necessary?

Adapted from National Wildlife Federation materials

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APPENDIX

SOURCES OF CLASSROOM ACTIVITIES

- **CAPTAIN HYDRO**
  Produced by
  East Bay Municipal Utility District
  P.O. Box 24055
  Oakland, CA

  Distributed by
  Office of Water Conservation
  Department of Water Resources
  P.O. Box 388
  Sacramento, CA 95802

  Captain Hydro is an upper-elementary workbook promoting water conservation. The student activities draw from many subject areas. East Bay Municipal Utility District has prepared Captain Hydro and other K-12 curriculum materials as part of Project Water.

- **CLASS PROJECT**
  National Wildlife Federation
  1414 Sixteeneth Street, N.W.
  Washington, DC 20036

  CLASS Project is Conservation Learning Activities for Science and Social Studies. These activities focus on environmental issues such as land use planning, solid waste management, and hazardous wastes. They are aimed at the junior high student.

- **ENERGY, FOOD AND YOU**
  Washington State Office of Public Instruction
  Office of Environmental Education

  Energy, Food and You is an interdisciplinary curriculum for secondary schools. It presents issues related to global food production and food-producing resources.

- **ENERGY LEARNING CENTER**
  Chevron USA, Inc.
  595 Market Street
  San Francisco, CA 94105

  The **Energy Learning Center** is a teaching unit aimed at introducing basic energy information and energy issues to students in grades 6-8. It is a packet of 18 "fact sheets," a time line, a poster, a teacher's guide, and activity duplicating masters.

- **ENERGY AND MY ENVIRONMENT**
  Governor's Energy Office
  Tallahasee, FL 32301

  Energy and My Environment is a K-12 energy education curriculum in three teachers' guides (K-6, 7-9, 10-12). The activities are organized around seven conceptual schemes.

- **ENVIRONMENTAL EDUCATION ACTIVITIES MANUAL**
  Edited by William Stapp and Dorothy Cox (1974)
  30808 LaMar
  Farmington Hills, MI 49024

  This six-volume activities manual is designed to provide K-12 experiences that promote basic environmental education concepts. Each volume has activiites to (1) develop sensitivity toward the environment, and (2) recognize problems, develop problem-solving skills, and take action to solve environmental problems.

- **GREEN BOX**
  Environmental Education Program
  Humboldt County Office of Education
  901 Myrtle Avenue
  Eureka, CA 95501

  Greenbox is a kit containing student activity cards, teacher booklets, program philosophy, and rationale. It is an individualized program for grades K-8; each card gives three activities (K-3, 3-6, 6-8) for the same concept.

- **IOWA DEVELOPED ENERGY ACTIVITY SAMPLER (IDEAS)**
  Iowa Department of Public Instruction
  Grimes State Office Buding
  Des Moines, IA 50319

  IDEAS consists of six secondary (grades 7-12) curriculum guides (home economics, industrial arts, language arts, mathematics, science, and social sciences). The curriculum is multidisciplinary and centers on incorporating energy topics into these six curriculum areas. IDEAS is sponsored by the Iowa Energy Policy Council in cooperation with the Iowa Department of Public Instruction.

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- **LAW IN AMERICAN SOCIETY**
  Journal of the National Center for Law-Focused Education
  Law In American Society Foundation
  33 North LaSalle Street, Suite 1700
  Chicago, IL 60602

  This journal is published four times a year. The February 1977 issue presents a series of articles about environmental issues.

- **LET'S RECYCLE!**
  U.S. Environmental Protection Agency
  Office of Water and Waste Managment
  Washington, DC 20460

  Let's Recycle is a booklet of lesson plans for grades K-12. These activities explore topics related to waste disposal. Each short activity description cites vocabulary and questions for discussion.

- **MANURE TO MEADOW TO MILKSHAKE**
  Hidden Villa, Inc.
  26870 Moody Road
  Los Altos, CA 94022

  Manure to Meadow to Milkshake is an experiential approach to helping students understand the interdependencies between their lives and the natural world. Although it is written by and for the Hidden Villa Environmental Project, it is full of easily adaptable activities, songs, plays, etc.

- **MARINE STUDIES IDEA BOOK**
  The Sea Grant Program
  University of Southern California
  Los Angeles, CA 90007

  The Marine Studies Idea Book is for grades K-6. It follows four central themes that cover the history, mythology, ecology, and politics of the sea.

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- **OUTDOOR BIOLOGY INSTRUCTIONAL STRATEGIES (OBIS)**
  Lawrence Hall of Science
  University of California
  Berkeley, CA 94720

  Published by
  Delta Education
  Box M
  Nashua, NH 03061

  OBIS is written to introduce youngsters to basic ecological concepts through highly motivating activities. These activities are aimed at youngsters from 10-15 years of age, and are primarily oriented toward community-sponsored youth organizations and nature centers.

- **PERSONAL VALUES AND ENVIRONMENTAL ISSUES**
  by Donald Scherer
  Hart Publishing Company, Inc.
  New York, NY 10003

  This book describes activities that help clarify values related to environmental issues. It covers issues of pollution, energy, food, population, and land use. Groups are to examine these issues as they are guided through the process for making responsible decisions.

- **PIONEERS**
  Interact Co.
  Box 262
  Lakeside, CA 92040

  Pioneers is a simulation activity that involves students in making decisions on a wagon train. Students work together around problems encountered on their journey westward.

- **PROJECT LEARNING TREE (PLT)**
  American Forest Institute
  1619 Massachusetts Avenue, N.W.
  Washington, DC 20036

  Cosponsored nationally by the Western Regional Environmental Education Council, **Project Learning Tree** is a supplementary program designed to complement existing curricula. PLT includes two activity guides: one for grades K-6 and the other for grades 7-12 made available through workshops. For information on workshops and local facilitators, contact Project Learning Tree, c/o Salina Star Route, Boulder, Colorado 80302.

- **PROJECT WILD**
  Salina Star Route
  Boulder, CO 80302

  Project Wild is in its early formative stages, intended to be published in 1985. It will be a supplementary program designed to promote an understanding of wildlife. Project Wild is cosponsored by the Western Association of Fish and Wildlife Agencies and the Western Regional Environmental Education Council.

- **SCIENCE 5/13**
  Macdonald Raintree, Inc.
  205 West Highland Avenue
  Milwaukee, WI 53203

  The **Science 5/13** books are for teachers to help children from 5-13 years learn science through investigative techniques. The lesson objectives link closely to Piagetian stages of conceptual development.

- **SCORING THE LOS ANGELES LANDSCAPE**
  UCLA Urban Environmental Education Project
  University of California
  Los Angeles, CA 90024

  Scoring the Los Angeles Landscape is designed to help learners become attuned to urban ecology. Activities cover components of urban systems, such as air, energy, transportation, population, etc. These activities are appropriate for use by teachers of secondary students.

- **SHARING NATURE WITH CHILDREN**
  by Joseph Bharat Cornell
  Anada Publications
  900 Alleghany Star Route
  Nevada City, CA 95959

Sharing Nature with Children is a collection of nature-awareness games for anyone who spends time with children. The games are simple ways to help children know nature's ways. Some are purely sensory experiences, some explore ecological principles, and some are just for fun.

- **SHAVER'S CREEK ENVIRONMENTAL CENTER**

Parks and Recreation Department
The Pennsylvania State University
University Park, PA 16802

Shaver's Creek Environmental Center operates a nature center and a resident outdoor school program—both serve as a laboratory setting for PSU students. The resident outdoor program staff designed and field-tested appropriate technology curricula for grades 4-12.

- **SPACESHIP SCHOOL**

Marin County Office of Education
1111 Las Galinas Avenue
San Rafael, CA 94903

Spaceship School activities are designed for direct use by kids. Subjects covered are energy, air, water, food, transportation, environmental inventories, and environmental monitoring. There are two sets of Spaceship School activity cards, grades K-3 and grades 4-6. The trial edition was developed by the Marin Museum of Natural Science in 1978.

- **SUNSHIP EARTH**

by Steve Van Metre
Acclimitization Experiences Institute
P.O. Box 288
Warrenville, IL 60555

Sunship Earth is an environmental education program for upper elementary students. It is designed for a residential setting and stresses understandings and feelings related to the natural environment.

- **THE NEW GAMES BOOK**

The New Games Foundation
P.O. Box 7901
San Francisco, CA 94120

The New Games Book is a starting place for those committed to the world of play. It exudes playfulness through creative, open-ended games. The only fast rule of New Games is "play hard, play fair, nobody hurt."

- **USE THIS**

The Western Regional Environmental Education Council
c/o Montana State Department of Education
Helena, MT 59601

Use This is a product of a joint effort between educators and resource managers. It describes techniques for examining curriculum materials available from resource agencies.

- **USING WILD EDIBLE PLANTS WITH CHILDREN**

by Carolie Sly and Molly Whiteley
School of Education (PDARC)
University of California
Berkeley, CA 94720

Using Wild Edible Plants With Children introduces children to plant uses through hands-on activities. This packet consists of ten cards covering plants common to California.

- **VALUES ACTIVITIES IN ENVIRONMENTAL EDUCATION (ERIC)**

The Ohio State University College of Education
1200 Chambers Road, 3rd Floor
Columbus, OH 43212

Values Activities in Environmental Education presents activities for clarifying values related to environmental issues. The activities are for grades K-12 and are suggested for science, social studies, and language arts classes.

- **WET AND WILD**

Marine Education Program
USC Institute for Marine and Coastal Studies
University Park
Los Angeles, CA 90007

Wet and Wild, a supplementary teacher's guide, is bilingual (English-Spanish), multidisciplinary, and contains ideas for classroom activities, background information, lesson plans, and references. It covers the physical ocean, ocean management, research, biological ocean, ecological ocean, and economic sea. The Marine Education Program also produces the Marine Idea Books for grades K-6 and 7-12.

California State Resource Agencies

California Coastal Commission
631 Howard Street
San Francisco, CA 94105

The Resource

he Coastal Commission, which includes one state commission and six egional commissions, was established by passage of a citizen initiative, Proposition 20, in the election of November 1972. The Coastal Commission was directed to do the following:

- Prepare a comprehensive, coordinated, enforceable plan for the orderly, long-range conservation and management of the natural resources of the coastal zone.
- During the planning period, to regulate development in coastal waters within a 1000-yard shoreline permit area to ensure that improper development would not undercut the plan being prepared.

he essence of the Coastal Plan is that the 1100 miles of California coastline hould be treated not as ordinary real estate but as a unique place where conservation and special kinds of development should have priority. The plan is designed to achieve long-term protection and roductivity of coastal resources in times of scarcity, as well as in times of bundance.

The Coastal Plan was completed and published in December 1975. Since then, the state and regional commissions have been overseeing the implementation of the Coastal Act of 1976 which grew out of the plan. Under this act, 67 coastal cities, counties, and four major commercial ports are required to develop local coastal programs which include land use plans and zoning ordinances. Once the Coastal Commission has reviewed and approved the plans, local governments will issue their own development grants. When all coastal communities have had their plans accepted, the Coastal Commission will be dissolved. Theoretically, all of these plans should have been completed by July 1981. However, at the time of publication of this Guide, it is anticipated that only one-half of the plans had been developed.

Long-Term Planning Needs

The Coastal Plan includes ten major categories with recommendations under each. These are described briefly as the long-range planning needs developed by the Commission.

Coastal Waters

Improve the productivity of the marine environment through control of overharvesting of marine life through stricter controls on dumping wastes into the offshore waters and through controlling the diking, filling, and dredging of coastal wetlands.

Coastal Land

Protect coastal streams and plan carefully for coastal watersheds by including provisions in local planning for protecting the quality of water feeding coastal wetlands, controlling sand supply and protecting spawning streams.

Retain natural habitat areas through acquisition, recreational controls and the regulation of adjacent development. Many plants, animals, birds, and marine creatures depend on the unique habitat provided by the coast and cannot survive elsewhere.

Encourage coastal agriculture through the alleviation of high property taxes and urban utility assessments, as well as through regulation of zoning and direct economic and technological assistance. The presence of the sea moderates the coastal climate, helping to extend the growing season and protect crops from frost damage. The rich alluvial soils in coastal valleys, combined with the temperate climatic conditions, create some of the finest and most productive agricultural land in the nation.

Encourage sustained yields in timber production by amending laws to tax timber only as it is cut, rather than taxing the value of all standing trees. Conserve soil and mineral resources by requiring that local building and grading ordinances include effective measures to prevent erosion. Sand and gravel extraction would be barred in environmentally sensitive or highly scenic areas, and site restoration would be required where mining is permitted.

Protect coastal air quality by requiring the cumulative impact of development on coastal air quality to be considered in land use and transportation plans. Major pollution-generating developments, such as refineries, fossil fuel power plants, and freeways, would be excluded from portions of the coastal zone now designated as problem areas for the maintenance of air quality unless there were no more environmentally sound alternatives.

Coastal Appearance and Design

Protect the scenic beauty of the coast by providing guidelines for visually unobtrusive new developments that are subordinate to the setting and use materials that blend with the environment.

Coastal Development

Encourage orderly, balanced development by requiring that new developments be concentrated in areas where the environment can support them with adequate water supplies, sewer services, and adequate road and public transportation capacity. Already developed areas would be favored for new developments. In rural areas not containing significant natural resources, scenic value, or viable agriculture lands, first preference would be given to the development of low profile facilities to serve coastal visitors. Residential development would be restricted to places where other types of development were not feasible. Hazardous industrial activities, such as liquefied natural gas processing, would be limited to areas where several facilities would be concentrated.

Energy

The plan recommends that the Energy Commission have authority over the siting of new power plants and all other major energy facilities including those for petroleum and for power plants. Power plant sites would have to be justified on the basis of no alternative sites, real need, minimal adverse visual impact, and, where feasible, provision of public coastal areas.

Offshore petroleum development would be permitted only if it is part of a national or western regional developmental plan. The plan also recommends revising current federal leasing practices to provide for withholding approval of offshore petroleum development until the exploration has determined the extent of the fossil fuel available and the environmental impacts from extracting it.

Tanker terminal construction would need to be justified on the basis of need beyond the existing facilities. Oil companies would be encouraged to trade oil supplies in order to reduce the need for new facilities and petroleum transport. Existing harbor areas should be used to accommodate Alaskan oil tankers with drafts of about 65 feet, and all other tankers should be restricted to deepwater terminals away from environmentally sensitive areas. Any new facilities would be developed for multi-company use.

Liquefied natural gas terminals would be restricted to a single operation until the public safety risks inherent in these operations are determined. If new terminals are built, they should be concentrated in already existing port areas.

Transportation

Limit adverse environmental effects of coastal access roads by improving the efficiency of already existing roads, promoting use of public transit, and paying special attention to weekend congestion problems. Coastal roads should include scenic parking areas, rest areas, beach access, and picnic grounds.

Provide for water and air transportation facilities within already existing port areas and avoid filling in wetland areas for this purpose.

Public Access to the Coast

Increase coastal recreation while protecting coastal resources through the location of parking areas that are away from the beach areas but with access. Where coastal communities are unduly burdened with providing visitor facilities, the plan recommends the use of state funds. Of course, all recreational areas would have to accommodate to the environmental capacity of the area to support tourism. Acquisition of additional recreation sites and encouragement of private developments to serve visitors is recommended to meet the rising demand for use of the coastal zone as a vacation and recreation area.

Encourage recreational boating but protect wetlands by requiring that new or expanded marinas be built in natural harbors, in deep water that is not marsh or wetlands, and in areas dredged from dry land. Dry storage, rental programs, multiple ownership, and other means, are also proposed to provide for more boating while protecting the wetlands.

Scientific and Educational Resources

Protect sites of scientific, historic, or educational value through an intensified effort to identify and provide protection for the coast's historic and archeological resources.

Restoration

Restore degraded coastal areas with a program that would reduce the numbers of undeveloped coastal lots through purchases and consolidation of lots under common ownership. Purchases are recommended to protect areas useable by the public and in areas where costs of extending urban services would exceed the costs of buying lots.

California Conservation Corps

1530 Capitol Avenue
Sacramento, CA 95814

The Resource

The California Conservation Corps employs 1800 youth between the ages of 18 and 23 on a one-year basis, at minimal wage standards, to work in resource management projects throughout the state. After an initial 20-day training period, the corps members are assigned to one of the 25 CCC centers across the state. At these local sites they may work on resource management projects operated under the auspices of any of the departments within The Resources Agency. The corps is also used in conjunction with local, city, and federal projects. Sample projects include forestry clearance, tree plantings, developing urban parks, and fighting forest and chaparral fires.

The California Conservation Corps is always looking for new members since the work term is limited to one year. Anyone between 18 and 22 who is interested may apply through any local Employment Development Department operated by the state government.

California Energy Commission

1111 Howe Avenue
Sacramento, CA 95825

The Resource

In the early 1970s, California faced the challenge of runaway growth in the projected demand for electrical energy. Large numbers of new power plants were being proposed for construction to meet that rapidly escalating demand. By October 1980, however, California utilities had cut their estimates of the levels of demand in the early 1990s by more than half. In that same month, Southern California Edison Company, California's second largest electric utility, announced a new corporate policy of substantial commitment to conservation and renewable energy resources to meet its electric power needs. These developments and similar actions by the Pacific Gas and Electric Company signaled the end of the energy challenge of the early 1970s.

The formation of the California Energy Commission in 1975 was a major step in the state's response to unchecked growth in electrical energy demand. Since then, the Commission has been a national leader in adopting cost-effective energy conservation standards for new buildings and appliances. The Commission has also been a strong promoter of solar and other alternative energy resources. During this period, the California Public Utilities Commission and the state's electric utilities have redirected many of their efforts into conservation and alternative energy resource development.

Energy conservation provides an increase in the real supplies of an energy source. It represents more efficient use of existing supplies and a reduction in the environmental impact that always accompanies the expenditure of an energy source. In fact, energy conservation is equivalent to an increase in the amount of human well-being that can be extracted from the energy supply.

The notion of a decreased impact on the environment is critical. One of the fundamental misconceptions about the relationship between economic growth and energy consumption is that they are parallel and inseparable.

Successful conservation in a number of ways has shown that this relationship is not fixed and economic expansion is possible without increased expenditures for energy supplies and greater negative impacts on the environment.

Long-Term Planning Needs

There are essentially four approaches to energy conservation that have both short-term and long-range effects for our lifestyles.

Through improved technology and/or operating procedures, we can increase the efficiency with which we use the same amount of energy without any decrease in services. For example, many buildings use excessive amounts of energy for heating and cooling because of inadequate insulation. Similarly, different brands of the same appliance can use energy more or less efficiently. The use of smaller automobiles with less weight and improved mileage per gallon is another source of increased energy payoff. Reduced lighting and heating when commercial buildings are unoccupied can also bring about considerable savings in energy expenditures. In each of these examples, the energy savings are achieved with little or no decrease in the services supplied to the consumer, although, as in the case of smaller automobiles, the environmental impact can be reduced significantly.

Different modes can be used for heating and cooling, transportation, packaging products, and increasing the durability of products that extend the efficiency of the energy source.

Freight transportation is an important example of this type of conservation. Although railroads are much more energy efficient for the movement of freight, there has been a steady increase in the use of trucks for this service during the past two decades. Public transportation systems, deteriorating or practically non-existent in many communities, are vastly more energy efficient than the use of private automobiles. Increased durability of such products as the automobile and appliances can also contribute considerably to the long-range reduction of energy consumption. More efficient heating and cooling systems that require less expenditures of energy for the same effects are another source of energy savings. For example, electric heating is very inefficient from the standpoint of energy consumption. Similarly, solar energy used for heating water in residential buildings is much more energy efficient than the use of petroleum. The quantities of heat generated by petroleum are excessive for the amount of energy needed to heat water.

In another dimension, the energy required to manufacture throw-away glass bottles or plastic containers could be reduced through the more energy efficient use of returnable bottles.

The mix of goods and services within the economy can be changed to increase the contributions to income and employment per unit of energy used with some adaptations of our lifestyles.

For example, more sophisticated communication techniques can be substituted for business travel. Less pleasure travel can also be compensated for by a change of emphasis in leisure activities. Other types of motorized recreation such as trail bikes and motorboats can replaced by less energy-consuming activities such as hiking and sailing.

Changes in energy consumption patterns can be brought about through changes which impose restrictions on energy use that directly affect our lifestyles.

The clearest example of this type of energy conservation is the rationing of gasoline. Smaller residences that require less heating and cooling is another example. Car pools, reduced speed limits, and higher taxes on larger automobiles are other examples of how this more drastic form of energy conservation can affect our lifestyles.

The California Energy System of Today

Oil supplies most of the energy consumed in California.

- California uses 1.9 million barrels of oil per day, about 61 percent of the state's total energy use.
- Imports, principally from Indonesia, total 450,000 barrels per day.
- In-state production is the state's largest supply source.
- Transportation sector uses 62 percent of petroleum products.
- Federal price controls are being phased out in 1981.
- World oil prices increased 2000 percent in the last ten years.

Natural gas is California's second largest energy source.

- The southwestern United States supplies over half of the state's needs.
- About 73 percent of home energy used is natural gas.
- Some gas prices will be deregulated by January 1985.
- Only P5 (power plant) users have experienced major curtailment in recent years.

Electricity supplies only ten percent of California's needs.

- Due to normal generation losses, it uses about 25 percent of our fuels.
- Demand growth rates are decreasing.
- Half of California's power capacity depends on oil and gas as fuel. Power plants used 100 million barrels of oil in 1979.
- Electric rates are rising steeply due to high oil and gas prices and capital costs.
- Electric utilities are closely regulated at the federal, state, and local level.

Conservation is a growth area in the California energy system.

- California is a national leader.
- CEC building and appliance standards reduce energy use.
- Individual business initiatives produce most of the conservation in the commercial and industrial sectors.
- Utility load management reduces peak demand for electricity.
- The state is active in developing regional and intercity rail and bus transportation.
- Federal new vehicle efficiency standards have significant effects on Californians.

California leads nation in use of solar energy.

- The major current applications are solar heating of water and swimming pools, passive solar building design.
- The major government action is the 55 percent state tax credit used for 70,000 installations since 1976.
- The solar industry was a $150 million business in California in 1980.

California Energy Extension Service
1600 Ninth Street, Suite 330
Sacramento, CA 95814

The Resource

When Congress passed the National Energy Extension Service Act in 1977 to set up pilot programs in ten states, they recognized that a neighbor-to-neighbor approach to conservation information might be the "something different" that was urgently needed to convince Americans to change their attitudes, behaviors, and actions towards energy conservation. After all, if your neighbors are talking about conservation and doing something about it, then it's time for everyone on the block to join the conservation effort.

This personal delivery of conservation information is what makes the Energy Extension Service (EES) different from other programs that the U.S. Department of Energy supports. Through the program, Congress expects to gain a better understanding of the barriers to the adoption of energy-saving measures by small consumers and hopes to reduce the impact of fuel shortages and price increases on small consumers.

The California Energy Extension Service is a $1 million federally funded energy conservation action program of the Governor's Office of Appropriate Technology. EES contracts with established local organizations in communities across the state to provide effective energy management services for users of small amounts of energy who have not been adequately served by other federal, state, and utility programs.

Major Coordination Role

EES is charged with mobilizing the resources of people and their ideas, providing technical assistance, filling gaps, providing links between programs and people concerned with energy management, and promoting the use of energy-conserving practices by those programs not traditionally concerned with energy in California. This has led to a number of programs being jointly developed with other agencies.

Management Philosophy

EES is not a passive education or information program, but one engaged in active outreach with personalized, targeted delivery of energy information involving one-to-one contact with people.

Contracts are the mode of funding, not grants, to assure accountability and appropriate use of public tax dollars. Contractors must submit monthly reports and are closely monitored on a business-like basis to assure effective program operation. Evaluation is an extremely important part of each EES program and is used as a management tool by both the contractors and EES staff. Where problems and barriers emerge, programs can be fine-tuned and adjusted accordingly. Contractors are also brought together periodically for verbal debriefing and peer evaluation which has also proven to be an effective learning process and transfer of knowledge in itself.

The demonstrations EES funds focus on developing programs that are transferable to other groups in other locales so that groups interested in operating similar programs don't have to reinvent the wheel.

Energy Education Program

The Energy Education Program is designed for students, teachers, administrative staff and maintenance personnel, all of whom have a role in and responsibility for energy management within a school. This program will develop models for how these individuals' activities can be coordinated to save energy in schools and educate students about energy. To accomplish this objective, a four part program will be implemented: model demonstration contracts with local schools, teacher training sessions, a clearinghouse/resource center, and an evaluation of existing materials and delivery of services. This program is funded by monies from the Environmental License Plate Fund and operated in cooperation with the Department of Education.

Solar Installer Training

EES manages the SolarWork Institute, funded by the Employment Development Department. The Institute provides instructional materials and resource assistance to solar installer training programs operated by community colleges, union apprenticeship programs, and community-based organizations. The Solar Installer's Training Program Manual is being purchased and used widely by training providers, solar businesses, and the general public. Four training programs have been established with Institute assistance

Energy Management Contracts

In 1980, its first year, EES funded programs addressing six types of energy users. Major contracts developed demonstration programs in gasoline conservation, agriculture, and local government. The EES **Community Energy Program** negotiated 20 contracts of up to $40,000 focused on small business, tenants and apartment owners, and underserved populations. All of these focus areas will be continued in 1981, with the addition of energy cooperatives. Major focus areas include:

- **Renters and Apartment Owners**
  Nearly 45 percent of all Californians live in 4 million units of rental housing and many small businesses rent their stores and office space. It is an area of potentially large savings, yet existing federal, state, and utility programs have generally not provided cogent incentives for energy management investment in the rental sector. EES programs vary depending upon the conditions which affect the relationship between the landlord and tenant who is responsible for utility bills.
- **Underserved Populations**
  Certain client audiences are particularly vulnerable to the rising cost of energy. This category develops informational resources and provides assistance for those to whom information is often denied for a variety of reasons. Most of the clients served by these programs are low income, living in substandard housing in need of repair, unable to decipher documents, and perhaps senior citizens or rural residents. The resources and skills often exist within these "communities" to provide their own services, although they are often under utilized.
- **Small Business**
  More than 400,000 small businesses exist in California, each with its own set of problems. For many business people, energy management is not perceived as a critical or high priority issue. Energy costs have been seen as fixed costs, or ones to just pass on to the consumer. Front end costs are perceived as too high, payback is seen as too long, even if the return on investment is 200 percent, and the terms conservation and audits have negative connotations. In addition, the audience is diverse; commercial, retail, and small industrial. Many small business people rent or lease their business space.

  EES Model Energy Surveys in Santa Cruz showed restaurant managers, car dealers, and grocery store owners how to save 30-40 percent in water heating, 25 percent in heating/cooling and ventilation, and 30 percent in delivery costs.

- **Energy Cooperatives**
  Neary 500,000 Californians are served by consumer cooperatives, many of these being food co-ops. In 1981, EES will be working with the National Consumer Cooperative Bank (NCCB) to create models of sustainable energy cooperatives. Energy co-ops enable consumers to pool their resources in an attempt to deal with the rising cost of energy. Co-ops can be formed to deal strictly with energy-related services and hardware, or these functions can be incorporated into the services provided by housing and food cooperatives. The EES is developing models for all three of these approaches and is investigating the possibility of energy producer co-ops, that is, nonprofit businesses that are owned and managed by the people who deliver these services. The EES money is to be used for technical and informational assistance and the staff and materials required to deliver these services. It is being supplemented by loans that will be paid back to the NCCB for hardware, inventory, etc.

Long-Range Planning Needs

- There is a need to build the capacity to sustain energy management programs and activities in local communities using local resources to meet national needs.
- There is a need to expand the marketing of targeted energy management information to reach tenants, apartment owners, homeowners, small businesses, women minority and ethnic populations, farmers, low income people, youth, and seniors.
- There is a need for better consumer information about:
  - energy conserving devices
  - energy management services, including contractors, energy auditors, shared-energy-savings firms, consultants
- Energy education needs to be infused through the curriculum with energy action programs at every school.
- Local funding of energy conservation and management programs through innovative financing mechanisms needs to be explored.
- Courses should be developed to update contractors and other professionals about energy-saving and alternative energy techniques in new and retrofit constructions for all sectors.
- Women and minorities need to be made aware of and encouraged to select careers in energy management and renewable resources. This extends from well-paying blue collar positions to those at the professional and managerial level.
- Energy management concerns need to be integrated into the comprehensive planning of each city and county.
- Attractive financing mechanisms for consumers and small businesses need to be further developed and expanded.

State of California
The Resources Agency

Department of
BOATING & WATERWAYS

Department of Boating and Waterways
1629 S Street
Sacramento, CA 95814

The Resource

The Department of Boating and Waterways is the agency that provides service to the boating community in California. The authority to operate and provide services comes from the State Resources Code and the Harbors and Navigation Code. The 1100 miles of coastal waters, over 1,000 lakes and reservoirs, and thousands of miles of rivers are navigated by an estimated 2.5 million recreational boaters annually. Countless others use this resource for a variety of other activities.

The services provided by the Department of Boating and Waterways include development of boating facilities, beach erosion control, environmental review, waterway planning, safety and education, enforcement, and yacht and ship broker licensing.

Long-Term Planning Needs

Develop and Preserve Public Boating Access

Recreational boaters and other aquatic participants require public access to the waters of the state. As land adjacent to the state's waters is developed by private interests and public access is limited, the need for the acquisition and preservation of public boating access becomes more important. The California Constitution, Article X, Section 4 states that without regard to the mode of aquatic use for any public purpose, the right of free and unabridged use of the state's navigable waters shall be maintained.

To assist the recreational boater in the use of public waters, the Department of Boating and Waterways develops public launch ramps, marinas, and other forms of access. These facilities are created to provide maximum enjoyment for the public with the least possible impact to the environment.

Conflicts Related to Access

The development of public access brings with it some concerns for environmental issues.

Conflicts that occur near the state's waters often include illegal trespass, litter, sanitation, and other similar problems. The acquisition of land adjacent to public waters can often **reduce** local conflicts. Where large-scale development means endangering riparian or wetland ecosystems, special efforts are made to minimize impact, or in come cases, enhance such areas.

Boating Safety

One of the most important functions of the Department of Boating and Waterways is promoting boating safety for the prevention of accidents, loss of life, and property damage. Assistance is provided to all statewide public boating safety courses offered by other agencies, such as Red Cross, U.S. Power Squadrons, U.S. Coast Guard Auxiliary, Scouts, YMCA's/YWCA's.

Educational services are provided to all public schools at a variety of grade levels. Films, coloring books, posters, and safety pamphlets are available without cost. Additionally, a complete high school boating safety course is offered. This course can be used as a separate offering, or as an element of another course. The materials for this course include textbooks, instructor guide, films, examinations, and handouts.

Department of Conservation
1416 Ninth Street
Sacramento, CA 95814

The Resource

As California's population grows, government planning at all levels for the use of land, now and into the future, is critical. Land use planning includes the recognition of geologic hazards (such as faults, landslides, coastal erosion) and other fundamental geologic knowledge (such as the location of mineral resources) which is related to safety and economic well-being of the citizens of California. To make these decisions wisely, planners need to tap different sources of information. Many of those sources are within the Resources Agency and several departments feed information into this process from the different perspectives of their expertise.

The Department of Conservation monitors the conversion of agricultural lands and administers the Williamson Act, a program that protects agricultural land that is in danger of being urbanized. In addition, the Department has an ongoing interest in the preservation and better use of soil resources. Data developed from these programs are made available to resource and land use planners to provide them with up-to-date information on which to base their planning.

The Division of Mines and Geology in the Department of Conservation has responsibility for collecting information about the surface and undersurface area of our landscape, including the location of earthquake faults and valuable mineral resources. Information about the location of mineral deposits is essential to the total picture that is needed in land use planning. Valuable mineral resources could be covered over by development and lost for use. Areas that are mined can be reclaimed for community use.

Two types of geological information are collected and disseminated by the Department of Conservation in the service of land use planning. One type focuses on a broad, general picture of the geologic structure and location of mineral resources throughout the state. Information of this type includes chartings of major earthquake faults. The data can be used to map out broad geographic areas where it would be safe to situate critical installations, such as dams and power plants.

The other type of geologic information focuses on specific sites. Studies are undertaken to identify land movements within a small area in the case of making decisions for siting a dam and reservoir. Earth shifts are studied over periods of time and estimates are made about the feasibility of a structure withstanding the impact of any earth movements. Many studies on the subject of earthquake faults are conducted in conjunction with local communities throughout the state for this purpose. Other studies are conducted in cooperation with federal agencies as part of broad land use planning at the national level.

One avenue for dissemination of the information collected by the department is through advisory services to local, state, and federal agencies on a variety of topics such as environmental impact assessments and mineral resources development, as well as outer continental shelf development, and the reclamation of mined lands.

A second avenue for dissemination is through publications which include *California Geology*, a monthly magazine, and scientific research reports.

The Department's Division of Oil and Gas has the role of encouraging the wise development of the state's oil, gas, and geothermal resources in a manner that prevents, as far as possible, damage to life, health, property, and natural resources.

Long-Range Planning Needs

As the nation's demand for adequate and reliable sources of energy increases, so has the need for the wise development of our oil, gas, and geothermal resources. The development and use of alternative energy supplies is a vital and growing component of our total energy program, although petroleum fuels will play a major role into the next century.

Many inquiries about oil, gas, and geothermal development are received by the department. As part of a program to handle these inquiries in a thorough manner, a wide variety of publications and maps related to oil, gas, and geothermal operations are prepared and distributed by the publications staff of the Division of Oil and Gas. Among the publications are field articles authored by division engineers and manuals describing recommended field practices written for oil, gas, and geothermal operators. An *Annual Report of the State Oil and Gas Supervisor* contains statistical data including production, injection, and reserve figures. Oil, gas, and geothermal field maps are published with field boundaries, well locations, and some well data. All of these publications are either distributed free of charge or sold at nominal cost.

Department of Fish and Game
1416 Ninth Street
Sacramento, CA 95814

The Resource

The Department of Fish and Game deals with the management of all wildlife resources within the state and coastal marine areas. Wildlife refers to all species of animals which are not domesticated, including aquatic animals, both fresh water and marine. Traditionally, wildlife has referred almost exclusively to game animals but there has been more emphasis recently on the ecological and aesthetic importance of nongame wildlife.

Wildlife is only one component of a complex interacting web of plants and animals. The interrelationships between organisms and their environments form the framework of ecosystems through which forms of life are sustained and the environment is continually renewed. The type of ecosystem which each wildlife species requires to survive is referred to as its habitat.

Most forms of wildlife require a specific type of habitat in order to survive. Because of the close linkage between species and their habitats, a major responsibility of this department is to identify these habitats and work to preserve areas for the species to survive in adequate numbers. Fish and wildlife serve several purposes. Many species provide recreation for anglers and hunters. Others are nongame fish and animals, and in addition to serving a function within their habitat, they contribute to the general gene pool.

Long-Term Planning Needs

Spawning and nursery areas for salmon and steelhead need to be cleared and spawning populations need to be increased.

Species of fish which migrate to the ocean to mature but must return to their fresh water origins to spawn are known as anadromous fish. Usually the spawning grounds are in streams and rivers, many of which are scores of miles upstream in the foothills and mountains. Among the anadromous species are salmon and migratory rainbow trout known as steelhead.

King (Chinook) salmon and silver (Coho) salmon are the only salmon that enter California rivers in significant numbers to spawn. Since the turn of the cnetury, salmon and steelhead populations have declined approximately 60 percent. Salmon, which annually support a $57 million recreational and commercial industry, produced a catch of 885,000 fish in 1978. The steelhead sport catch approached 122,000.

The Klamath River system, largest of the coastal California rivers, currently supports approximately 66 percent of the king salmon and [illegible]5 percent of the silver salmon that spawn in California's coastal rivers. The 3600 square mile Eel River system is the second largest coastal river spawning area. However, the numbers of salmon passing the Benbow Dam Fishway on the Eel River in Humboldt County have declined dramatically since counting was begun. The most recent counts indicate that the king salmon runs are relatively stable but the silver salmon runs are continuing to decline.

The Sacramento/San Joaquin Valley river systems support the remainder of the salmon and steelhead resource in the state. King salmon are the only salmon of any importance in this system. There are four major runs each year—fall, late fall, winter, and spring.

Several problems related to the damming of California rivers have adversely affected the salmon population. For example, gravel deposits which are essential to the protection of eggs and young fish have been lost through sedimentation and erosion. Replacement gravel that normally is transported downstream from upriver areas is now held behind the dams. Heavy metal contamination from mining operations and changes in stream flow patterns are other factors related to dams. Predators and water diversions, limited nursery areas, and other hazards, also affect the survival rate of young fish between hatching and reaching the ocean. In addition. large numbers of salmon are caught from the ocean by commercial and sport fishermen.

The present status of wetlands and modified wetlands needs to be stabilized and additional wetlands need to be acquired or preserved through incentives to private owners.

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Of the approximately five million acres of wetlands which existed prior to European settlements, 91 percent have been lost. Coastal marshes have fared slightly better than inland marshes with about a 75 percent loss. Up to 94 percent of the freshwater wetlands of the Central Valley have been destroyed. Most wetland losses result from reclamation and water development projects related to agriculture, urban sprawl, and road construction.

Wetlands include a broad array of areas where land, water, and vegetation interact. They are generally inundated by enough surface or ground water to support vegetative or aquatic life that require saturated conditions for growth and reproduction. Some wetlands, such as vernal pools, can be saturated during the winter and dry out during the summer.

Wetlands are known for their value as habitats for wildlife. At least 50 fur and game species in the United States, exclusive of waterfowl, inhabit wetlands to obtain food, water, or protective cover. Wetlands are also essential to many aquatic species, both fresh water and marine, as breeding grounds and as nursery areas for the young until they are large enough to move into deeper waters.

However, the essential value of wetlands is their contribution to the natural food cycle and their great biological productivity which is sometimes said to be nearly ten times that of terrestrial land on a per acre basis. In these settings, dead plant matter and dissolved nutrients such as phosphates, nitrates, and ammonia act as the basic building blocks of the ecological food chain. Rich plant and invertebrate life flourish and they, in turn, support the fish populations as well as the feeding needs of birds and sometimes mammals.

Wetlands also serve a function of filtering pollutants and renewing water supplies, although this benefit can be lessened by overloads. Marshes, estuaries, and other types of wetlands are capable of removing inorganic nutrients, such as sewage phosphates and nitrates, and recycling them into the food chain, an expensive process when carried out in artificial systems created by humans.

Wetlands also filter stream flow sediments which settle in the bottom of the wetland and eventually bring about its demise through infilling. If natural processes are not interrupted by man's activities, in time every marsh becomes a wet meadow or upland, although the process, as it proceeds

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naturally, can take thousands of years. As the watersheds around wetlands are stripped through timbering, development, and other activities, the delicate water-soil-vegetative balance can soon be overcome. The sedimentation rate is accelerated, water circulation is reduced, and stagnation and eutrophication tend to kill off the natural inhabitants and create breeding grounds for mosquitoes.

The Central Valley wetlands are particularly important as a stopping point and terminus for the Pacific Flyway which covers the western portion of the North American continent and portions of the Artic and eastern Asia. Most waterfowl using this flyway are hatched in the praries of western Canada and the river valleys and deltas of Alaska. Most of these birds winter from Washington to Mexico for about 60 percent of the flyway's total population. Approximately 10 to 12 million ducks and geese, accompanied by hundreds of thousands of shorebirds and other water-related birds, annually winter or pass through the Central Valley.

Key habitats need to be acquired, restored, and maintained for more than 900 species of fish and wildlife in California, including 212 presently identified species of rare, endangered, or threatened plants and animals.

Our understanding of the environment and the complex web of relationships that are essential to its successful functioning is still largely a mystery. The delicate balances which are characteristic of a single ecosystem fan out in every direction into the creation of increasingly complex balances with other living and nonliving organisms that are parts of other ecosystems until the entire planet can be seen as one ecosystem. The central and profound question faced by every expert in resource management is to discover where to enter into the solution of an environmental problem. This is the question faced by fish and wildlife managers in determining the choice of habitats that will generally enhance the welfare of our entire wildlife populations and, at the same time, enhance the quality of life for the inhabitants of our state, nation, and world. For this reason, probably the best approach to understanding the needs for habitats that can accommodate and nurture as many species of wildlife as possible is to describe the research and the types of knowledge about our environment, its inhabitants, and mutually shared habitats that we will have to develop within the near future. Listed below are a number of research topics that need to be studied along with the ongoing acquisition, restoration, and maintenance of habitats.

- Learn how judicious management can be applied to achieve harmony between the needs of wildlife and other uses, such as road construction, timber harvesting, and land use for recreation.
- Determine the ideal habitat conditions for various species of wildlife in different locations and at different points in their life cycles.
- Determine instream flow needs of fish populations on a stream-by-stream basis.
- Develop a marine nearshore habitat-type inventory, cataloging the habitat types in the nearshore marine ecosystems so that changes in the ecosystem can be evaluated and specific effects determined.
- Learn how the habitat requirements for wildlife species may conflict with other uses, such as the use of forest forage by domestic animals as well as wildlife.
- Identify the effects of bird populations on controlling insects which damage valuable timber species.
- Appraise damages to forest vegetation caused by wildlife species and determine acceptable control methodology.
- Study the effects of timber harvesting on livestock grazing on food and cover for different species of wildlife.
- Identify the characteristics of prime-fish habitats and determine the effects of land and water management.

Department of Forestry
1416 Ninth Street
Sacramento, CA 95814

The Resource

The Department of Forestry, located within the Resources Agency, and operating under the policies of the State Board of Forestry and Public Resources Code, is responsible for providing fire protection and watershed management services for the protection of private lands and state-owned lands in California, outside of the incorporated cities.

California includes a total land area of 100,191,000 acres. It is the third largest state in the country in terms of land area. About 33 percent or 32,558,000 acres are classified as forest areas. However, only about 16 percent of the total land area of the state is considered as commercial forest lands. These are forest lands that are suitable for growing and harvesting timber in a continuous cycle. The total resources managed by this agency include about 33 million acres of timber lands, range lands, and wildlife and fish habitats. Any public area with about 10 percent of forest cover is considered to be forested whether it is used for recreation, range grazing, or other purposes.

There are two major forest regions in the state. One is an intermittent strip stretching 450 miles along the coast from Monterey to the Oregon border with a maximum width of 40 miles in some places. This is the habitat of the California redwood along with other important commercial tree species such as the Douglas fir and white fir. The world's tallest tree, a 367-foot coast redwood, is located in this area in the Redwood National Park. The second major forest area is a pine region that extends the full length of the Sierra Nevada and along the inner mountain ranges from Oregon southward to just north of San Francisco Bay. The principal species in this region are ponderosa, jeffrey, white fir, red fir, and some hardwood species.

California ranks second in lumber production in the country; 35 to 40 percent of the timber harvested comes from the national forests. The balance comes from privately owned tree farms. Californians also consume more products based on wood processing than any other state in the nation. These products include labels, printing papers, newsprint, packages, furniture, and charcoal briquettes. As our technology increases, the processing of wood-based chemicals is becoming a new and important industry with widespread applicability. One example of a wood-based chemical is torula yeast, a high protein product made from wood sugars spent in the pulping process. One variety, Type S, is used in baby foods, cereals, baked goods, and beverages. Type F is used in feed supplements for commercial domestic animals. Still another variety, Type FP, is used in pet foods. Other wood products, such as ethyl cellulose and similar chemical-based celluloses, are used in making a variety of products including football helmets, photographic films, medicines, fertilizers, and cosmetics.

Forests also provide us with another resource that we are just beginning to recognize. That is clean air. Through transpiration, the forest gives up moisture and oxygen to renew the earth's atmosphere. The present climate of the earth is partially determined by the size and location of forest lands on the planet. The effects of forestation on climate are immediately noticeable in urban areas where natural growth serves a variety of functions.

The forests also provide the habitats which are indispensable to the maintenance of living organisms of all types. Many species of birds and other wildlife animals depend on various stages of forest succession for their habitats. Even the anadromous fish such as salmon and steelhead that spawn in California rivers depend on a forested watershed for the water supply that makes possible their annual journeys up the streams and rivers. Domestic animals that graze on the rangelands under management by this agency are a source of food and other materials which are important for the maintenance of our lifestyles.

Long-Term Planning Needs

Growth and harvest of timberlands needs to be managed to assure a consistent yield and continuing renewal of forest resources.

Timber production in California has steadily declined for the past two decades. This is due partially to the withdrawal of commercial timberlands for other uses such as parks and wildernesses, as well as commercial development. The Forest Service classified 7.6 million acres of privately owned land in the state as commercial forest land. Information available about the condition of these lands is spotty and the annual yields vary widely.

The most dependable source for timber production is approximately 2.7 million acres of commercial forest land owned by companies with forest product mills. An additional 1.5 million acres are owned by companies that regularly supply the mills. These companies manage their lands on a continuous yield basis. The total acreage in these ownerships is increasing and the number and size of these holdings has been changing generally toward fewer and larger companies.

At present about 35 percent of the harvested timber comes from the national forests and the remainder comes from privately owned tree farms. Continued conversion of private commercial forest land to nonforest use if decreasing the productive capacity of the state to provide the needed timber. However, under recent legislation, counties can designate land as Timberland Preserve Zones (TPZ) which can be used only for production of forest products. Tax allowances are also granted which make the investment profitable. By 1978, 75 percent of the private commercial forest land was in TPZs.

The old growth inventories are continuously being reduced and replaced by young growth through commerical harvesting and reforestation. Replanting is making the California forests more ecologically diverse than ever before. However, the overall quality of timber is reduced as the young growth increases and the old growth decreases. Parks, wilderness areas, and other preserves are becoming the last refuge for old growth.

Reforestation of 1.4 million acres of timberland, mainly in private ownership, is an important need for the immediate restoration of the productive capacity of the commercial timberlands. State cost-sharing plans are in operation to encourage the reforestation of privately held lands. Vegetation management programs also are being implemented in young timber stands to increase forage production, water yields, wildlife habitat, survival of seedlings, and growth rates. Through vegetation management, damages from fires and soil erosion are expected to be diminished or averted.

Massive urban reforestation is needed to improve the quality of life in these areas.

When the 1978 legislature passed the Governor's Urban Forestry Program, it began a new era for the California Department of Forestry. Ninety-four percent of the population of California lives on two and one-half percent of the land. Many of these areas are currently losing trees faster than they are replaced through insects, diseases, old age, vandalism, and urban development.

Forestation in urban areas offers many advantages for improving the physical and visual impact of the environment. For example, carefully placed trees can shield a building from the sun's direct rays during the summer more than during the winter. Shrubs can also shield walls from direct heat of the sun. Vegetation cools the environment during hot weather by reflecting much of the sun's rays, unlike concrete that absorbs the heat all day and radiates it at night to raise the ground temperature. Trees also create breezes by attracting warm group air up as coolness is created by transpiration through leaves. Equally important is the aesthetic impact trees, shrubs, and other plantings have on the appearance of our environment and our mental well-being. They also provide an urban habitat for animals such as song birds and, in some areas, ground animals such as squirrels. Urban forestation also reduces noise pollution.

Several aspects of urban forestry are currently under study as part of a nationwide project sponsored through the Federal Forestry Service. One task is to select trees and other plantings that require minimal supplies for the semi-arid urban environments that characterize California. In some areas, deciduous trees that lose their foilage during the winter are most desirable for use in energy conservation. During the summer, they provide shade protection from the heating effects of the sun's rays. However, during the winter the sun's less powerful rays can permeate the bare limbs and provide heat. Another thrust is to develop resources and values that will cause people to participate in urban reforestation programs. Already, in many parts of the state, groups are working to recruit volunteers for major replanting projects.

Urban reforestation, to be sustained over years, will depend on cheap and readily available supplies of seedlings and young trees for replanting. This will require the establishment of urban greenhouses and other urban sources for the acquisition of all types of planting. Because of the newness of the program, these facilities are still in the planning stages with consideration for such factors as optimal locations for creating urban employment and the variety of plants and trees that would be most desirable for a particular urban location.

Forest fires are a major threat to the depletion of our forest resources, the loss of wildlife, and the destruction of built environments.

California leads the nation in its unique wildland fire problems. The historic approach of adding more expensive and sophisticated fire suppression forces can no longer be maintained. It is not only too costly but the end effects of relying on this approach exclusively are less productive than other methods.

One approach that holds promise for reducing the threats of fires is to reduce the fuel loading of old growth within the forest and on chaparral lands. This requires regular and controlled burning off of the undergrowth in the forest and on the open chaparral lands. By purposely burning off the shrub undergrowth before it becomes too thick, fire temperatures can be kept within the range that will not be damaging to the established tree growths. However, by allowing the undergrowth to build, when fires are started, the heat becomes intense enough to destroy all plant life including the trees. Burning off the chaparral areas, allows for the gorwth of grasses and other plants less dangerous in terms of being fire hazards. Interestingly, it has been established that wildlife populations prefer forested areas in which the undergrowth is kept down. Thickly forested areas with excessive amounts of underbrush are generally avoided by wildlife populations. Hence, this resource management technique also benefits preservation and growth of wildlife in the forested areas.

Research needs to be conducted and methods developed for the use of residues from timbering and waste materials from forest clearance as an energy source.

There is a long list of benefits that could occur from the systematic harvesting of wood residues for energy production. For example, wood is a renewable, biodegradable, and naturally stored fuel. Clearing forests of the undergrowth that creates devasting forest fires not only ameliorates that problem, but also decreases the need for hazard reduction burning. Clearing forests of logging residues for the production of energy is an added stimulus for improved silva-cultural practices which can offset some forest improvement costs.

Wood conversion technologies are relatively simple and potentially more reliable than technologies using coal and oil. This source of energy can be refined and packaged in rural areas, providing employment and self-sufficiency for these areas. It is also a potential source of income to landowners who can clear their own lands and sell the waste materials to a local wood conversion operation.

Several avenues for the eventual use of this resource are currently being explored. For example, one project explores the use of hardwood-encroached lands. The hardwood timber is used for energy production as the lands are replanted with softwoods, more useful in commercial timber production. Other studies are being conducted on the economic feasibilities of using wood as an energy source. One project conducted jointly by the California Energy Commission and the Department of Forestry is demonstrating the technical and economic feasibility of using a gasifier/engine generator system to supply electrical requirements for a conservation camp operated by the Department of Forestry. Eventually, a step-by-step procedure for establishing similar systems throughout the country will be produced.

Studies are also being conducted on the effects of the clearing of logging residue and underbrush on the nutrient cycles in different areas. At present, these studies show no adverse effects. Urban parks, such as the Golden Gate Park in San Francisco, generate large volumes of wood residues from maintenance and replacement activities. The Golden Gate staff, in collaboration with the Department of Forestry, has developed a program to use the residues, providing an alternative to conventional heating fuel sources and mitigating the problems of residue disposal.

Department of Parks and Recreation
1416 Ninth Street
Sacramento, CA 95814

The Resource

About six million acres of California's mountains, deserts, and coast are managed for park and recreation purposes by various federal, state, and local agencies. The California Department of Parks and Recreation, as part of its overall responsibility for statewide planning and policy in the park and recreation field, manages about one million of these acres within the California State Park System. This includes some 250 state parks, beaches, wildernesses, natural preserves, historic sites, and recreational areas throughout California.

The State Park System accommodates more than 60 million days of visitor use each year in camping, picnicking, fishing, boating, sightseeing, and a hundred other activities, including many kinds of environmental learning experiences.

Everyone thinks of parks as places for recreation where you can hike, swim, picnic, or play baseball. One of their important purposes is to provide a release from physical tensions, a health-building experience. They also serve as a unique setting for understanding our history and our cultural heritage. But most importantly, they are places where men and women may come to discover, understand, and appreciate the interrelationships and interdependencies between people and their environment. They are a means of making us aware of the world around us. They provide a chance to see that world as it is naturally, not as modified by other human beings. They expand our sense of values beyond the merely economic. They provide an opportunity for contemplation, reverie, solitude, and peace. They are "islands of hope."

Long-Term Planning Needs

Increasing public demand needs to be met, while sustaining the high quality park experience.

Park use continues to increase at an even faster rate than the state's population. Thousands are turned away at popular parks and recreation areas during peak vacation periods. Existing facilities are strained, sometimes even to the detriment of the resource itself as when deeply rutted trails erode a meadow, or constant use of a campground compacts the soil and suffocates redwood roots.

Lands that are suitable and available for park use are not unlimited, and competition for land of any kind is becoming increasingly intense. Costs for both acquisition and development continue to rise. Funding to operate and maintain existing facilities becomes more difficult to obtain. Comprehensive long-range planning is essential to meet human needs while preserving the environmental quality on which all else depends.

More urban parks need to be developed and many that exist need to be upgraded.

Ninety-four percent of California's citizens live in urban and suburban areas on two percent of the land. Urban parks and recreation areas are essential in many ways to the preservation of our health as a society. Often, they provide the only open space for relaxation and recreation in congested areas. Urban parks with natural growth such as trees and bushes reduce pollution, reduce noise, alleviate temperature extremes, reduce energy consumption, provide soil and watershed protection, improve urban wildlife habitat, and beautify neighborhoods. They also often serve as the only continuing contact which people have with the natural environment, and provide an aesthetic quality that exists nowhere else in an urban area. The importance of urban parks is now being recognized, and they can be expected to receive increasing attention in the years ahead.

Parks and their programs need to serve a broader population, particularly minorities, the disabled, and the elderly.

Many of those who most need the benefits parks can provide are unable or disinclined to use them. A major effort in park systems at all levels is to make park and recreation facilities more accessible to the disabled, to develop programs that will more effectively serve minorities, the elderly, and other populations with special needs.

There is a need for greater public involvement in planning parks and in operating them.

Public involvement is being increasingly recognized as the foundation for good planning. People need to participate in all stages of the planning process so it can be responsive to their needs. And they are needed more than ever when the plans come to fruition; many park programs would not exist without the help of dedicated volunteers. Parks need people as much as people need parks.

New strategies must be found to help parks become more self-sufficient economically.

Park values should not be measured solely in terms of economics, but neither can economics be ignored. Parks must compete for public dollars, and the more nearly they can become self-supporting, or find ways to offset some of their costs, the better they may be able to afford some of the things that do give parks their highest value.

There needs to be a new look at how people get to parks.

In spite of people's reluctance to abandon their cars, transportation patterns may be changing. It's becoming less and less feasible to travel halfway across the country to go through 20 parks in as many days. The cost-conscious are staying closer to home and remaining longer in one place. Interest in public transportation is reviving. Park planners, hopeful that the day of giant parking lots is passing, feel whole new concepts may be necessary.

How to use parks in environmental education

You don't have to go to Pt. Lobos to learn about the natural environment. A patch of weeds at an asphalt playground will illustrate most environmental principles. But, because these great places **are** outstanding, they command attention. A trip to the redwoods or the desert makes a lasting impression that no child can forget. A wilderness experience can only be had in a wilderness.

Learning about how people lived in an historic period can give perspective on how we live today, on the choices we make about how we use our environment. And there is a profound difference between actually going to a place and just reading about it. That's not to say you should overlook the park next door, either. It, too, can offer a variety of habitats, of plants and animals—and, all too often, a drastic contrast with its surroundings—that can be used in a lot of teaching ways.

The California Department of Parks and Recreation has environmental living programs at several of its units, where classes can stay overnight and "re-live" the life of an historic period. But these programs can only handle a relatively small number of classes and are usually booked far in advance. Some parks have shorter, daytime programs of a similar nature. Efforts are being made to mesh the park system's offerings with this new statewide environmental education curriculum, and most parks have at least some informational materials on the resources they have available. At the very least, there is almost always a ranger with whom you can discuss your needs.

save water
DWR

Department of Water Resources
1416 Ninth Street
Sacramento, CA 95814

The Resource

The Department of Water Resources provides leadership for the management of California's water resources. The Department's programs are designed to implement a California constitutional requirement that the state's water be put to the fullest possible beneficial use, and that waste and unreasonable use of water be prevented.

Water, seemingly, is everywhere. It covers three-fourths of the world's surface as a liquid. It is also present in the atmosphere in a gaseous state and large amounts exist in a solid state as the polar ice caps. The water in the oceans and the ice at the polar caps comprise 99.3 percent of the water on the planet. The remaining 0.7 percent, at any one time, exists in the atmosphere, lakes, rivers, soil, and subsurface deposits. Water is the primary constituent of all animal and vegetable matter and the processes of life depend on a constant interchange of water between living matter and the environment.

California has 12 hydrologic basins into which water from precipitation flows. The total annual supply of water in California is estimated to be 31.3 million acre feet, although average annual precipitation amounts to about 200 million acre feet. (An acre foot equals approximately 326,000 gallons.) The difference between precipitation and availability is lost for human use through evaporation from the surface of vegetation, ground, and water, through transpiration from vegetation, and through runoff to the oceans.

The runoff from precipitation in these twelve basins is one major source of the water we use. Most of the state's runoff occurs in the north coast and the

Sacramento basins. This is also where the two major forest areas in the state are located, one running down the coast from Oregon and the other following the mountain ranges to the east of the valley from Oregon to the San Francisco Bay Area. In terms of both water supply and water quality, the condition of the flora in the upper regions of a runoff basin is critical. The high, steep portions of the basin usually receive the largest proportion of the rainfall and the vegetation on these slopes, if it is thick, prevents the erosion of soil, allows the runoff, and enhances absorption of the water into the soil, ensuring a well-regulated runoff flow and good quality water.

The second major source of water supplies is the underground deposits called aquifers. These are natural reservoirs which water seeps into and is stored. Aquifers develop very slowly over long periods of time that can range to thousands of years.

A quick survey of the figures for average annual runoff in each of the basins reveals that there is an uneven distribution of rainfall and the need for water in California. The largest population centers are in the south were the least amount of rainfall occurs and the water reserves are the smallest. Similarly, the San Joaquin and Tulare Lake basins are the sites of a large percentage of the most productive farmlands in the state. Water management practices, traditionally, have developed storage and transport systems—dams, reservoirs, canals and aqueducts—that can ensure a constant supply of water from the high rainfall areas to where it is needed.

Human needs for drinking water are far less than needs for washing, flushing toilets, and other ways in which water is consumed in daily living. Industrial needs consume considerably more water in manufacturing processes and in generating power than humans do in daily living. Agriculture, however, is the single most water-consuming activity in the world. In California, agriculture uses 85 percent of the total amount of water consumed in the state. Most of this is lost through transpiration as crops mature and through evaporation as the land is irrigated. Following are estimates of some water requirements:

USE	AMOUNTS REQUIRED	
	Liters	Gallons
Drinking water (adult daily)	1	0.26
Toilet (one flush)	20	5.28
Clothes washer (one load)	170	44.88
Refine a ton of petroleum	2,000 - 50,000	528 - 13,200
Produce a ton of steel	6,000 - 270,000	1,584 - 71,280
Grow a ton of wheat	300,000 - 500,000	79,200 - 132,000
Grow a ton of rice	1,500,000 - 2,000,000	396,000 - 528,000
Produce a ton of milk	10,000,000	264,000
Produce a ton of beef	20,000,000 - 50,000,000	528,000 - 1,320,000

Long-Term Planning Needs

Present overdrafting of groundwater supplies is threatening the availability of a continuously dependable supply of water in the future.

Groundwater is stored in aquifers which are natural underground reservoirs in porous rock below the soil surface. The location of aquifers is dependent on the permeability of the soil and rock layers in an area. Groundwater, obtained through drilling wells, is the cheapest and most accessible alternative to surface water supplies. When groundwater is withdrawn at a rate greater than the recharge rate, the water table drops, increasing the depth to which wells must be drilled. Since drilling costs increase rapidly with depth, withdrawing the groundwater can become uneconomical. In these cases, aquifers can be thought of as a nonrenewable resource that has been mined out. Often, not only the groundwater resource is lost. Surface streamflows can be severly reduced with the lowering of the water table and ecologically important wetlands can dry up. In coastal areas, depletion of freshwater aquifers can lead to the intrusion of saltwater, and, again, permanent loss of the resource.

Groundwater supplies have been permanently depleted in parts of Arizona and in the high plains of Texas where water tables have fallen up to 30 meters. The principle overdraft area in California is the San Joaquin Valley where the safe yield of groundwater is exceeded by 1.7 million acre feet each year. Without other supplies of water, a region can suffer a serious decline economically and in other related ways. Moreover, the decline in groundwater supplies also threatens the maintenance of a dependable supply of water in dry years and can also cause economic decline because of periodic droughts. In some areas, development moratoriums have already been declared because of serious declines in the water table.

There are two basic approaches to dealing with the problem of overdrafting groundwater. One approach is to develop a comprehensive statutory system of groundwater law. This requires the establishment of groundwater management areas based on the survey of geological conditions and the identification of major groundwater basins.

The other approach is to recharge the aquifers during wet years using technology that will allow for quick absorption of the water by the porous rock. Aquifers, in one way, are very preferable to surface reservoirs because of the evaporation problem which can be particularly severe in hot, dry areas. For example, losses through evaporation at Lake Mead have been measured at one cubic kilometer per year or about 4,500 liters (1,190 gallons) for each person in the United States.

Waterlogging and salt accumulation on irrigated lands is threatening agriculture production.

Waterlogging, salinization, and alkalinization commonly occur when irrigation systems, particularly in arid lands, don't allow for proper drainage. As the water flows through the soil, salts and other solid deposits are filtered out and these accumulate. The San Joaquin Valley is the region most seriously affected by this problem. About 400,000 acres at present have high brackish water tables that pose a threat to the productivity of the land. When the water table reaches the root zone productivity is sharply curtailed. It is estimated that 700,000 to one million acres will seriously be affected by this problem by the year 2000. Lost crop production could reach $320 million annually by the year 2000. One approach to this problem is to install subsurface drainage systems for individual fields and a master drain for a large area. This can be very expensive both initially and in the maintenance of the system to assure continued adequate drainage.

A more economical approach is to grow more salt tolerant crops such as barley, cotton, and sugar beets. Studies are being conducted to test the effects of brackish water on these types of crops.

A third approach is to build desalting plants. So far, however, the desalting process has been very expensive. In 1975 there were about 700 desalting plants in the world but almost none were used in agriculture. Larger plants averaged a cost of around 15 cents per cubic meter and smaller ones ranged from 25 to 50 cents. This price excludes use for all but very high-value crops such as tomatoes, avocados, and orchards. Experimental plants are in the design stages using biomass conversion, solar pond power generation, and recovery turbines in conjunction with ponds and marshes in an attempt to reduce the cost of the desalted water.

Widespread water conservation practices can reduce the need for developing new water supplies in the future to meet the needs of an increasing population and industrial growth.

The most economical and environmentally safe way of increasing the real supplies of water is to conserve through reduced consumption, using the existing supplies more efficiently. However, probably because of the widespread presence of water and its importance for our existence, it has not often been thought of as have other natural resources such as petroleum, minerals, and coal. As a consequence, the methods for water management and use have been quite different from those methods used for the other natural resources. For example, water has historically been very cheap regardless of the supply, and even in areas or times of shortage it has been put to low-value uses such as watering lawns or filling swimming pools with no regard for the consequences to higher-value uses. Water consumption has been accepted almost as a personal right. Instead of placing limitations on its use and practicing conservation, emphasis has been placed on transferring supplies from one water basin to another which sometimes has had disasterous environmental consequences.

In fact, a substantial part of municipal water use in the United States is the result of leaks, including running toilets, and dripping faucets as well as letting a tap run unnecessarily. Retrofit devices have been used effectively to reduce consumption. For example, 35 major urban areas throughout the state showed a 21 percent reduction in water use in 1977 compared to 1976. Water conservation has persisted to the present time and is still 17 percent less than in 1976.

Industrial uses also account for much of the wasted water. A good proportion of quantities required by industrial processes can be recirculated instead of being permanently withdrawn from existing reserves.

Irrigation, the prime consumer of water in California, can be managed more efficiently from the standpoint of water consumption. For example, high frequency irrigation, using smaller amounts at more frequent intervals and through pipes, has the potential for saving considerable amounts of water. The use of computers in this operation has the potential for further increasing conservation effectiveness. As mentioned above, planting crops that are more tolerant of the salt content of water is another way in which agriculture can increase its efficient use of water.

Probably the most effective means for conserving in the consumption of water will be found in adjusting prices to reflect the scarcity of this resource in a particular region. Heretofore, society has subsidized people living in arid regions by making the cost of water artifically low. Through pricing practices that reflect the actual scarcity of the commodity and adjustments to prevent the demise of industries such as agriculture, it is hoped that water management practices will be brought more in line with the economic laws that govern scarcities of the other natural resources.

Water distribution systems need to be further developed to meet the expected needs for water by the year 2000.

Projections place the demand for dependable supplies of water in California at 4 million acre feet annually by the year 2000. With effective conservation programs, this figure can be reduced to 3.4 million acre feet per year. As noted above, the major areas for water supply are in the north and the areas of greatest need are in the San Joaquin Valley and the coastal areas in the south. The source with the greatest potential for supplying water is the Delta region in the Central Valley. It is here that the flows from the Sierra Nevada, cascading down the western slopes in a myriad of streams, converge in the Central Valley to form the greatest river system within the boundaries of a single state in our country.

Some of the problems related to using this area as a major source of supply for other parts of the state are political and some are environmental. Often, in the past, water has had a peculiar local nature that is not attached to other natural resources. Some areas can enjoy an abundance while adjacent areas suffer from a scarcity. People and industries upstream can pollute water through a variety of ways such as the runoff from fertilizing practices without regard for the consequences to people's needs further downstream. In other cases, upstream areas can siphon off most of the water supplies for activities such as irrigation and leave inadequate amounts for those areas closer to the mouth of the river or stream.

The use of water from the Colorado River is a case that illustrates both of these points. Originally, Mexico was not included in the water sharing agreement and, as a result, very little flow was left by the time the Colorado River reached that area. Salinization from irrigation later became a problem when it reached such high proportions that the water, once it crossed the Mexican border, was virtually useless. Fortunately, both of these problems have been settled in an amicable way.

The political power manifested in the sheer numbers of people in the southern coastal region has been perceived, in some instances, as the only reason why water diversification projects are being planned. Extreme sentiments against these plans in the northern areas have led to abortive threats to take actions such as seceding from the state.

There is also the fact that plans to divert large amounts of water from the Delta to the southern areas will produce negative environmental effects in the north such as the influx of saltwater through the San Francisco Bay and the Carquinez Straits. Others say that controlled releases of water to the Delta would protect the San Francisco Bay-Delta Estuary and the Suisun marsh while also providing good quality water for transport to the southern part of the state.

The controversy surrounding the movement of great amounts of water from one basin to another is being experienced in other parts of the world such as in the controversy that erupted between India and Bangladesh when the former drained much of the water out of the Ganges River to flush out the Calcutta Harbor and seriously depleted the supplies needed for irrigation by its neighbors.

All of these problems are, in turn, an indication that people and nations all over the earth are becoming more aware of water as a limited natural resource. As demands on the available water increase, this resource is being viewed more as other natural resources are and is being subjected to the same economic laws that regulate their use.

State Lands Commission
1807 - 13th Street
Sacramento, CA 95814

The Resource

The State Lands Commission acts as the manager for about 4.5 million acres of land held in trust for the people of California. One portion of these holdings, about 4 million acres, was acquired as sovereign lands when California joined the Union in 1850. Approximately the size of Connecticut and Delaware combined, these lands include the beds underlying about 30 navigable rivers throughout the state such as the Klamath and Sacramento, the basins of almost 30 navigable lakes such as Lake Tahoe and Clear Lake, and the three-mile-wide strip of tide and submerged land adjacent to the coast and offshore islands. The other portion of these lands, about 610,000 acres, is the remainder of a federal grant made to California shortly after statehood to support public education. In that grant, the state was given two square miles out of each 36 square miles held by the federal government. Originally, that amounted to about five million acres, most of which was quickly sold to private holders. The remaining portion, no longer subject to sale, is currently being consolidated through exchanges with other public land holders into larger blocks that are more economically useful.

The Commission is composed of two elected public officials, the State Controller and the Lieutenant Governor, and one cabinet level officer appointed by the Governor. This composition was determined in 1938 when the Commission was formed to assure that public interest in the use of these vast holdings would be safeguarded. Revenues from the original school lands are still used for support of the public school system.

Long-Term Planning Needs

Energy and resource development on the lands managed by the Commission needs to be promoted and guided by the procedures that will provide the most benefit for the citizens of California.

Oil and gas deposits on state lands, particularly in the tidelands and submerged offshore areas, are an important resource that is being developed through the collaboration of the public and private sectors. Average daily production of oil on state lands is approximately 100,000 barrels. Revenues for 1981-82 are estimated to be enough to enable the Commission to produce more revenue than any other nontax state agency. The Commission has successfully formulated firm procedures to avoid oil pollution accidents caused by wells on state-owned lands as evidenced by the fact that not one major incident has involved wells located on lands leased by the state. One reason for this successful record is that potential environmental impacts are rigorously assessed before any drilling operations are allowed.

The largest geothermal electric generating complex in the United States is located in Sonoma County at The Geysers. More than half of the steam used to generate electricity at this site comes from state geothermal leases. Over a half million acres of state-owned land are located in regions with geothermal potential although only a small portion of that area has been explored. The Commission's task is to promote full use of these resources while safeguarding environmental quality and maximizing economic benefits to the public.

Other resource development activities include timber harvesting and grazing leases on the remaining school lands. Additionally, although the state sold large portions of the original school lands grant, mineral rights were retained on 716,000 acres. Consequently, now the Commission leases some of its rights for mining operations and collects royalties for the production of sand, gravel, precious metals, iron, and other minerals.

General development of lands managed by the Commission needs to be promoted in a manner that safeguards public use of all navigable waters within the state.

Almost since California became a state, the legislature has granted tide and submerged lands in trust to cities and counties so that these regions could develop harbors and waterfronts in accordance with locally developed plans. In many places, these granted lands have been developed into marinas, harbors, aquatic parks, and other types of recreational areas. Although these lands are under local control, the Commission has responsibility for monitoring the sites to ensure compliance with the terms of the statutory grants. These grants, traditionally, have been designed to encourage the maximum development of tidelands in a manner that is consistent with the public's best interest while requiring the grantees to reinvest any revenues produced back into the lands where they are generated.

The Commission also has authority to issue permits for the dredging of harbors and waterways that have become obstructed with mud or silt. These permits are granted to both public and private parties. Other dredging initiated by the Commission is done to improve the configuration of the shoreline and to reclaim private and public lands.

The Commission also has responsibility for two public service projects. One project resulted from the 1977-78 drought. When waters receded as a consequence of the drought, a large number of hazardous objects such as pilings, discarded junk, and other large objects were discovered within the navigable waters in many areas. The Commission has been given responsibility for a massive undertaking to identify these hazards and remove them. Current efforts are being concentrated in the areas of Lake Tahoe and the Sacramento/San Joaquin Delta. These efforts also include the removal of abandoned oil drilling equipment in the tidelands and submerged areas.

The second project, to clarify water boundaries, is the result of more intensive use of waterfront lands. Because land was abundant and put to low density use until recently, many early land descriptions which involved water boundaries were vague and uncertain. Within the last 50 years the determination of these boundaries has become a problem of increasing proportions. Now, it is estimated that more than 7,000 miles of common water boundaries between public and private lands are in dispute. The Commission has relied on historical records, maps, minutes of public meetings, archives, and interviews with historians and local longtime residents as some of the sources for resolving these disputes. The resolution of these land title problems is important not only to protect the public's resources, but also to enable private parties to obtain sufficient title insurance.

State Solid Waste Management Board
1020 Ninth Street, Suite 300
Sacramento, CA 95814

The Resource

In 1972 the California State Legislature established the State Solid Waste Management Board to develop and maintain a state program of nonhazardous waste management and resource recovery which would protect public health and safety, promote economic productivity and environmental quality, and conserve natural resources.

Californians generate about 46 million tons of nonhazardous waste each year and pay approximately $600 million annually to have it disposed of in various ways. Presently, most solid waste is landfilled. However, landfill sites are becoming less available, and it is anticipated that only three-fourths of the present capacity for disposing of solid waste in this way will exist by the end of 1990. Unless other options for the disposal of solid waste can be developed by that time, California will be faced with a serious garbage crisis.

The Legislature acted in 1977 through SB 650, the Litter Control, Recycling and Resource Recovery Act, to give the State Solid Waste Management

Board responsibility to develop public awareness of the crisis, foster a new ethic toward waste disposal, and develop new systems to recover materials and energy from garbage. The board's management activities include state and local planning, enforcement of environmentally sound landfill practices, recycling, resource reuse and energy recovery, litter control, waste reduction, and public education.

Long-Term Planning Needs

Fortunately, there are alternative systems to landfill disposal of solid waste. However, each of the options has advantages and disadvantages that need to be taken into consideration when developing a long-term plan for solid waste management. The following assessments describe alternative methods for dealing with the growing waste generated by our society.

METHOD: Waste Reduction

Waste can be prevented at its source by altering manufacturing processes, product and packaging design, patterns of consumption and waste generation to conserve natural resources and energy, and to extend product lifetime. Examples include purchasing products with minimal packaging, manufacturing more durable and fuel-efficient products, and reusing products rather than disposing of them.

PRO	CON
ECONOMIC Reduces municipal disposal costs. Reduces energy used in manufacture. More efficient use of natural resources. Can create new job opportunities.	Major capital investments for industry. Intrudes on free enterprise system. Loss of feedstock and revenues for resource recovery projects. Can create job dislocation.
ENVIRONMENTAL Reduces litter and pollution. Preserves natural resources. Promotes efficient land use.	Sanitation problem from storage of reusable food containers.
TECHNOLOGICAL Existing technology is used to create more durable products.	Additional research needed to create more recyclable products. Product design technology is insufficient.
IMPLEMENTABILITY Can be done by all sectors. Requires minimal initial effort by consumers.	Resistance to change in behavior by citizens, government, and industry. Lack of external incentives discourages participation. Conflicting data impedes decision making. Inadequate public awareness.

CONCLUSION

Waste reduction is the initial and most important alternative to solid waste disposal. However, it is a highly complex and controversial issue because it is intertwined with philosophical considerations regarding the role of government; the functioning of the free market; the relative value of social, economic, and environmental factors; and concepts regarding the quality of life as measured by the consumption of material goods.

METHOD: Landfill

Landfills are now the final repository for most solid wastes. The wastes are unloaded, compacted so as to reduce the volume, and covered with soil.

PRO	CON
ECONOMIC Inexpensive alternative (approximately $3-5 per ton). In some cases, energy recovery from landfill-produced methane gas may be economical.	Landfill costs are expected to increase because of increased haul distances and compliance with environmental standards. Capital costs for land close to waste sources is increasing due to urban development.
ENVIRONMENTAL Previously unusable land (e.g., gravel pits) have been reclaimed for some social use.	Use alternatives for usable land are limited. Poor operations may result in odors, propagation of disease vectors such as flies, groundwater pollution, and/or migration of explosive gases. Most landfills will be energy consumptive. Energy and material resources in the wastes are lost. Even with gas-recovery energy resources are not fully used.
TECHNOLOGICAL No new technology is required for existing practices in landfill operation.	Environmental monitoring, control, and cleanup techniques for odors, gas migration, and groundwater pollution are not well developed.
IMPLEMENTABILITY Landfills are needed for residuals of any alternative.	Poor landfill operations create adverse public impressions, creating barriers to obtaining land-use permits.

CONCLUSION

Landfill is perceived by the public to be less desirable than resource recovery and common belief is that landfills are obsolete, unneeded, unacceptable, and a waste of resources. Its economic advantages will rapidly diminish with increased haul costs. The requirements for new landfill will not disappear but will be diminished by implementation of resource recovery.

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METHOD: Composting

Organic wastes (paper, leaves, food, etc.) can be converted into humus-like compost through aerobic (with air) bacterial decomposition.

PRO	CON
ECONOMIC Small scale composting is not capital intensive.	Large scale composting is capital intensive. The commercial compost market is very limited and is currently being served with compost made from other wastes (sewage, sludge, manures, wood bark, etc.).
ENVIRONMENTAL Represents a closed loop ecological cycle whereby substances grown from the land are ultimately returned to the land for recycling. Improves soil and increases productivity of humus-deficient soils. Reduces landfill space requirements by 60-70 percent.	Composting is energy consumptive; requires approximately 1.5 gallons fossil fuel per ton of compost or 1,500 BTU/lb. to process. Heavy metal impact on crops from sludges are under study. Odor, nuisance, rainfall runoff, and leachate must be controlled. Requires controlled operations to insure destruction of pathogens present in sludge.
TECHNOLOGICAL The composting technology is proven for conversion of organic material. Composting technology is not complex.	Removal of pieces of plastic and glass shards from waste is preferable to ensure quality of the finished compost.
IMPLEMENTABILITY Vegetative composting appears easy to implement on a local basis for local consumption.	Acceptance by farmers of refuse-derived compost is problematical. Repeat compost markets are limited; market and usage are not constant.

CONCLUSION

Composting has the potential of reducing landfill space requirements, yields a beneficial soil amendment, and is easily implementable; however, impediments in developing composting as a practical alternative exist in the level of control required to produce a safe quality product, lack of constant markets, and resistance to use of composts produced from municipal refuse.

METHOD: Source Separation
Waste materials to be recovered (metal, glass, paper, etc.) are separated at the point of generation (household, office, etc.) for collection.

PRO	CON
ECONOMIC Little or no processing required to produce marketable material. Permits use of systems for handling low volumes of materials at each collection point with a very high yield at the central collection depot.	Increased labor and collection equipment is required if participation exceeds 20 percent. Profits are very vulnerable to market fluctuations and (except for paper) to container legislation. Major profit taking occurs at the central collection depot.
ENVIRONMENTAL Increased education of the public, reduced consumption of virgin materials, and reduction of energy required through use of recycled materials. Can reduce landfill requirements for municipal refuse by an estimated 20 percent maximum assuming 100 percent participation and 100 percent retrieval efficiency.	Collection at many separate sites increases energy consumption. Data available indicate that the participation required to significantly reduce landfill requirements will be very difficult to achieve and sustain.
TECHNOLOGICAL No new technology required for single family or commercial pickup.	Multi-family residential technique still developing.
IMPLEMENTABILITY Has been implemented commercially for many years on specific items such as corrugated paper. Can be implemented immediately in some localities. Can be implemented with little capital investment.	Large scale implementation has not been achieved. Data on costs and market impacts are unreliable. Volumes and revenue are vulnerable to changes in participant behavior.

CONCLUSION
Source separation increases public awareness of the solid waste problem and has the potential to reduce projected increases in waste generation and requirements for processing facilities. This is the only system theoretically capable of achieving a 25 percent reduction in landfilled waste in the near future, but only by participation that has not been achieved anywhere on a large scale.

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METHOD: Mechanical Separation and Production of Refuse-Derived Fuel

The municipal waste stream has a significant glass, metal, and energy content. These wastes can be mechanically separated into usable or salable products through combinations of devices called "front-end" systems. Waste materials that have been shredded and air classified can be used in conversion processes to create energy, chemicals, or compost. These conversion processes are called "back-end" systems. A densified RDF (dRDF) that is more easily transported and stored can be produced through pelletizing or chemical modification but at additional expense.

PRO	CON
ECONOMIC The system can be customized for specific markets. Magnetic ferrous separation is economical in some areas.	Substantial operating costs are involved. Produces more contaminated materials than source separation, hence affecting market value. Usually more expensive than direct haul to presently available landfill.
ENVIRONMENTAL Permits conversion or reclamation of up to 80 percent of the municipal waste stream. Shredding of wastes reduces landfill acreage and cover requirements by up to about 30 percent.	Requires mitigation measures to control air, noise, or water pollution at processing facilities. Disposal requirements for residual materials not well known.
TECHNOLOGICAL Mechanical facilities can handle the large quantities of waste generated. Shredding and magnetic separation are fully developed operations.	Shredders require extensive servicing. RDF, unless densified, is difficult to store and handle. Densified RDF (pellets, dried and powdered) adds significant cost and has not been adequately tested for economic benefits in a large scale operation.
IMPLEMENTABILITY Facility can be developed in stages as markets develop and as conversion processes are defined.	Runs risk of needing redesign as markets change.

CONCLUSION

Mechanical separation can remove some materials from the waste stream but valuable products still remain to be reclaimed. Materials removal and size reduction will make landfill operation easier. Production of RDF for use in existing facilities is the most economical alternative but currently has a very limited market. Introduction of coal-fired facilities or new facilities with ash-handling capabilities are needed to make the production of RDF an attractive alternative on a large scale.

METHOD: Direct Combustion

The energy in wastes may be recovered by directly firing all or part of the wastes independently or with fossil fuels (co-combustion). Raw refuse can be fired in boilers designed for that purpose. Refuse-Derived Fuel (RDF) produced by shredding and air classification can be burned in boilers with ash handling capabilities such as those fueled with coal or wood waste.

PRO	CON
ECONOMIC Minimal cost for energy conversion if existing boilers or cement kilns are available ($4-7 per ton net costs). Production of steam could have large potential market (yet to be documented).	Usage in California requires new or extensively modified boilers. Competes with low-cost coal if boiler has ash-handling capability. Steam quality is lower than optimum for electrical power generation.
ENVIRONMENTAL Landfill requirement reduced 70-90 percent, depending on process. Energy recovered is greater than processing requirements. Could supplement use of increasingly scarce fossil fuels.	Air emissions are still under investigation but system may have more difficulty with air quality impact regulations than with emission standards. Best management of residues under development.
TECHNOLOGICAL Well developed in Europe and being demonstrated in the United States. Many small sized systems have been installed in Eastern United States. Steam recovery equipment is similar to proven solid fuel fired boilers using wood waste and coal.	The ability to control air emissions in accordance with California standards is a problem that is expected to be controllable but probably at considerable expense. Use in cement kilns adequately demonstrated but site specific and expensive at best.
IMPLEMENTABILITY Steam energy source welcomed by industry.	Air pollution regulations are constantly being tightened. Requires assured supplies of waste.

CONCLUSION

Direct combustion is attractive from an economical point of view. However, severe implementation problems exist due to environmental pollution controls. Further evaluation is required in terms of capital and operating costs, corrosion hazards, reliability, residue, and environmental impacts.

METHOD: Pyrolysis

The destructive distillation of organic wastes in an oxygen deficient atmosphere is called pyrolysis. Two full scale systems (200 TPD) have been built and operated. One system used pure oxygen and produced a 370 BTU/SCF gas that can be transported but is not being actively marketed at this time. The other system uses preheated air and produces a 100 BTU/SCF gas that is not transportable and is used directly in a boiler. Smaller systems have been developed and operated with some success, but there is no commercialization at this time. Gas production appears the simplest and most likely development and is discussed below.

PRO	CON
ECONOMIC There is a large demand for the gas produced since it can be substituted for natural gas in industry with minimum modification. The gas produced may possibly be converted into high value hydrogen, methanol, methane, or ammonia (some are readily transported and all are derived almost exclusively from natural gas). Has the least net cost of all options examined when implemented in large scale and used for high value chemical feedstock products. Can supplement costly fossil fuels.	Capital intensity plus high operating costs make this an expensive energy option. Market analysis for high value products is not complete due to complexity. The gas is not economically storable. Lower cost systems may evolve, especially from coal gasification technology.
ENVIRONMENTAL No major air pollution problems expected. Further testing is planned. Reduces volume of landfill requirements by 80-95 percent. Slagging system produces totally inert residue. Energy recovered is greater than processing requirements.	System waste water discharges requires extensive treatment. Gas produced is toxic and unsuitable for domestic use. Conversion efficiency is lower than direct combustion.
TECHNOLOGICAL Combustion of gas (such as boilers) is state-of-the-art; conversion to chemicals may have unquantified development.	Conversion of the gas to high value products has not been demonstrated. Use of the system in a large scale operation has not been demonstrated.
IMPLEMENTABILITY The high marketable products may attract financing. Market for gas is available. Equitable distribution of benefits is achieved by conserving natural gas for residential use.	Capital intensity and high operating cost mandates assured waste flow and product utilization. Requires large systems for economy and large quantities of dilution water for sewage treatment.

CONCLUSION

Pyrolysis appears to be the best potential alternative environmentally, and may become economically competitive with direct combustion as fuel prices and availability change. However, limited knowledge of present markets requires further analysis to verify the economic viability of producing the high value products and to determine an optimum product mix.

CALIFORNIA STATE RESOURCE AGENGY MATERIALS FOR CLASSROOM TEACHERS

FOR USE IN TEACHING ABOUT THE NATURAL ENVIRONMENT

Title: **Be Careful with Our Stately Treasures**
Description: A colorful poster showing each state's tree (limited printing).
Topic: Plants
Grade Level: 4-6
Agency: State Department of Forestry

Title: **Don't Join the Bucket Brigade, Leave Tide Pool Life Alone!**
Description: Poster; good for elementary and adult.
Topic: Ocean life
Grade Level: K-12
Agency: State Department of Fish and Game and the University of California Sea Grant Program

Title: **Endangered Wildlife of California**
Description: A timely booklet, well illustrated, describing endangered wildlife in California. It also lists rare and extinct species in California as well as a federal list of California endangered species.
Topic: Endangered species
Grade Level: K-12
Agency: State Department of Fish and Game

Title: **Fish, Wildlife, and Plant Species in California Designated Endangered or Rare**
Description: A listing of species rare or endangered in California.
Topic: Endangered species
Grade Level: 6-12
Agency: State Department of Fish and Game

Title: **Geology of Placer Deposits**
Description: A booklet detailing methods and techniques which can be useful in discovering gold-bearing placer deposits.
Topic: Geology
Grade Level: 10-12
Agency: State Department of Conservation

Title: **Marine Mammals of California**
Description: This booklet begins with a comprehensive description of the various modifications of marine animals and of the Order Letacea. Whaling and whale conservation, and the Marine Mammal Protection Act are also explained. The bulk of the publication illustrates and describes 34 of the marine mammals seen or identified near California.
Topic: Marine mammals
Grade Level: 6-12
Agency: State Department of Fish and Game and the University of California Sea Grant Program

Title: **Species Booklets**
Description: A series of 12 booklets offer information on many California fish and game species as well as nongame species. All have photographs and/or drawings identifying species. Descriptions of habitat, natural history, and distribution are also included.
Topic: Wildlife
Grade Level: 4-12
Agency: State Department of Fish and Game

Title: **The California Gray Whale**
Description: A brochure with excellent color photographs. Content covers biology of the gray whale, the migration, endangered status, and guidelines for whale watching.
Topic: Gray whale
Grade Level: 4-12
Agency: State Department of Fish and Game

Title: **Thanks to You We Still Have a Home**
Description: A colorful poster showing a variety of birds on vegetation representative of their environment (limited printing).
Topic: Animals/birds
Grade Level: K-6
Agency: State Department of Forestry

Title: **The Plants and Animals of Folsom Lake**
Description: A detailed guide to the diverse natural communities surroundig Folsom Lake State Recreational area.
Topic: Plants and animals
Grade Level: 10-12
Agency: State Department of Parks and Recreation

Title: **Wildlife Leaflets**
Description: Excellent one-page leaflets, each dealing with a single species of wildlife. Almost all familiar vertebrates are described.
Topic: Wildlife
Grade Level: 4-12
Agency: State Department of Fish and Game

Title: **Wildlife—The Environmental Barometer**
Description: A pamphlet detailing the importance of a healthy environment for wildlife and the potential harm of man-made changes. Details harmful changes caused by man which may affect all of life, including man. "By saving wildlife man may save himself."
Topic: Wildlife
Grade Level: 4-12
Agency: State Department of Fish and Game

FOR USE IN TEACHING ABOUT THE BUILT ENVIRONMENT

Title: **A Description of the Set of Minerals and Rocks Furnished to California Schools by the California Division of Mines and Geology**
Description: A pamphlet filled with photographs and excellent chemical descriptions of minerals as well as a discussion of their economic worth and where they can be found in California.
Topic: Geology
Grade Level: 4-12
Agency: State Department of Conservation

Title: **Simplified Geologic Map of California**
Description: A postcard to commemorate the state centennial. Color coded to indicate age and rock type.
Topic: Geology
Grade Level: 4-12
Agency: State Department of Conservation

FOR USE IN TEACHING ABOUT SOCIAL INSTITUTIONS AND DECISION MAKING

Title: **Adventures in Public Transit**
Description: The learning activities are geared to Orange County but the format could be used elsewhere. The activities are approached as a "magic window experience" with firsthand observations to see, do, record, evaluate, and value.
Topic: Transportation
Grade Level: 6-8
Agency: State Department of Transportation

Title: **Checklist for You and the Environment**
Description: This brochure sets forth simple, everyday methods by which all Californians can reduce waste.
Topic: Waste reduction
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Closing the Loop***
Description: This filmstrip describes the "hows" and "whys" of recycling.
Topic: Recycling
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Composting**
Description: This slide show describes the process which diverts organic wastes from landfills and yields a rich soil amendment.
Topic: Composting
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **The Davis Experience**
Description: A reprint from *Solar Age* (May 1978) describing the Davis energy study, their energy building code, and city planning strategies that maximize the use of solar energy.
Topic: Solar energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Estimating Utilities' Prices for Power Purchases from Alternative Energy Resources**
Description: A technical report that estimates the future costs of conventional energy resources so that cost comparisons with renewable and decentralized energy resources can be made in a more economically competitive manner. The information presented is an interesting case study of the role of the economic forecasting in present energy investment decisions. Includes data on California's electricity supply by fuel type and estimated costs of generating electricity with a variety of fuel types.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Fact Sheets** (single items available for reproduction)
Description: A series of information bulletins covering a wide range of solid waste management topics: waste reduction, oil recyling, recycling, composting, the Solid Waste Management Board, waste to energy, glossary of solid waste management terms, citizen action for a waste-efficient California.
Topic: Waste management
Grade Level: 10-12
Agency: Solid Waste Management Board

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*Filmstrips also available as slide shows

Title: **The Garbage Crisis** (teacher background information)
Description: This brochure gives overview of the Solid Waste Management Board's activities statewide for 1980.
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Great American Wild Waste Show**
Description: Videotaped vaudeville performance by the Twelfth Night Repertory Company. Teaches four "R's" of solid waste management—reduce, reuse, recycle, recover.
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Industry Recycles***
Description: This filmstrip describes current methods of recycling employed within various California industries.
Topic: Recycling
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Joint Investigation by the California Energy Commission and the California Public Utilities Commission into the Availability and Potential Use of Solar Energy in California**
Description: A technical report that outlines the desirability of using solar energy for domestic water heating and passive space heating. Useful as a benchmark in studying the history of solar-related legislation in California. Recommendations for incentives utilities can use to motivate their customers to use solar energy are outlined. This publication can be used as a checklist of the progress made by the utilities in carrying out the recommendations listed.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Passive Solar Design—Here and Now**
Description: Details and pictures various architectural designs which promote the collection, storage, and use of solar energy. Explores historical ways passive solar energy was used by the Greeks and Romans, the Mesa Verde Indians, and the residents of New England. Good discussion of the various ways that heat moves. Illustrates the effectiveness of passive systems and the importance of energy conservation.
Topic: Solar energy
Grade Level: 6-12
Agency: California Energy Commission

Title: **Salvaging Demolition Waste**
Description: This slide show details innovative reuse and recycling of construction and demolition debris.
Topic: Salvaging
Grade Level: 6-12
Agency: Solid Waste Management Board

Title: **Saving Energy at Home—It's Your Money**
Description: Pamphlet illustrating how energy can be conserved at home.
Topic: Energy conservation
Grade Level: 6-12
Agency: California Energy Commission

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*Filmstrips also available as slide [illegible]

Title: **Solar Water Heaters in California 1891-1930**
Description: A magazine-type publication describing the use of solar energy to heat water. The technology is not as new as some people imagine.
Topic: Solar energy
Grade Level: 6-12
Agency: California Energy Commission

Title: **Solid Waste Management Resource Persons** (for large assembly presentations)
Description: Speakers available for presentations on variety of solid waste management topics: State Solid Waste Management Board, duties and functions; California's garbage crisis, controlling litter, waste reduction, resource recovery, recycling, salvaging and demolition wastes, and composting.
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Solid Waste Posters**
Description: Set of seven colorful posters depicting the good, bad, hilarious and silly ways in which we operate and simple "do-able" ways for us to change for the better: "Great Garbage Machine," "Technology!" "Why Recycle?" "Buyer Be-Aware!" "Recycling Is for Everyone!" "Running Out/Running Over!" "Garbage Is What You Throw Away!"
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **State Solid Waste Management Board**
Description: This slide show gives an overview of California's Solid Waste Management Board membership, history, and functions.
Topic: Waste management
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Transportation Alternatives—Student Handbook**
Description: A booklet which presents the modes of transportation. It can be used at home to do a self-transportation survey along with family involvement.
Topic: Transportation
Grade Level: 3-7
Agency: State Department of Transportation

Title: **Trash Monster**
Description: Interdisciplinary, two-week environmental education unit. Teaches students resource conservation skills. Complete sets of materials and procedures provided.
Topic: Waste management
Grade Level: 5-7
Agency: Solid Waste Management Board

Title: **Waste Reduction—A Consumer Action**
Description: This slide show is an examination of consumption/throw-away habits and simple, everyday measures to combat waste.
Topic: Waste reduction
Grade Level: 7-12
Agency: Solid Waste Management Board

Title: **Waste-To-Energy***

Description: This filmstrip describes the evolving technology of waste utilization as a resource to fill California's growing energy needs.

Topic: Energy

Grade Level: 7-12

Agency: Solid Waste Management Board

Title: **Wildlife—The Environmental Barometer**

Description: A brochure describing how wildlife can be used to assess the health of the environment.

Topic: Wildlife

Grade Level: 10-12

Agency: State Department of Fish and Game

Title: **Wizard of Waste**

Description: An interdisciplinary, two-week environmental education unit. Teaches students resource conservation skills. Complete sets of materials and procedures provided.

Topic: Waste management

Grade Level: 2-4

Agency: Solid Waste Management Board

FOR USE IN TEACHING ABOUT RESOURCE MANAGEMENT

Title: **A Guide to the Urban Water Conservation Garden**

Description: This brochure gives valuable information for planting a variety of gardens (rock gardens, shrub beds, vegetable gardens, etc.) on one side; the other side is a poster of a model garden.

Topic: Water conservation

Grade Level: K-12

Agency: Department of Water Resources

Title: **An Introduction to the Energy Resources of California**

Description: A comprehensive "primer" on nonrenewable energy resources: oil gas, and geothermal. It includes a descriptio of the geology of petroleum deposits and the various steps needed to produce oil from drilling to refining. A fold-ou map of California shows the known petroleum and geothermal deposits.

Topic: Petroleum/Energy/Geology

Grade Level: 10-12

Agency: State Department of Conservation

Title: **A Pilot Water Conservation Program**

Description: A 1978 publication describing the Department of Water Resources public outreach program on water conservatio during the drought. Specific water conserving devices an habits are outlined and the public's response to implementing water conservation strategies is discussed.

Topic: Water conservation

Grade Level: 7-12

Agency: State Department of Water Resources

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*Filmstrips also available as slide show

Topic: **California Solar Information Packet**
Description: A pamphlet illustrating basic solar design principles, passive solar applications, and active solar systems.
Topic: Solar energy
Grade Level: 7-12
Agency: State Energy Commission

Title: **Decade of the Sun. Program for Maximum Implementation of Solar Energy through 1990**
Description: An excellent overview of California's Solar Program present and future, a review of the state-of-the-art of various solar technologies, potential electric energy savings with solar.
Topic: Energy/Solar
Grade Level: 10-12
Agency: California Energy Commission

Title: **Domestic Solar Water Heating—A Builder's Guide**
Description: A pamphlet describing the basic components of a solar domestic water heating system with illustrations.
Topic: Solar energy
Grade Level: 6-12
Agency: California Energy Commission

Title: **Energy Farming**
Description: A study of plant crops which could be used as a biomass for fuel. Economics of energy farming is discussed in conjunction with varied energy conversion routes and products from biomass.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Environmental Impact Report for California Energy Commission Solar and Wind Programs**
Description: An excellent overview of the state's wind and solar programs describing the technologies, their impacts on air and water quality, and the potential of the resource for displacing nonrenewable energy resources.
Topic: Energy/Wind
Grade Level: 10-12
Agency: California Energy Commission

Title: **Excerpts from State Fire Laws Applicable to Forest Fire Prevention**
Description: A small pamphlet describing the fire permit process, techniques for fire hazard reduction, and penalties and liabilities related to behavior during forest fires.
Topic: Forest fires
Grade Level: 7-12
Agency: State Department of Forestry

Title: **Fire Hazard Reduction**
Description: A one-page handout diagramming the techniques for reducing fire hazards around a forest dwelling, as well as plans for building a chimney spark arrester.
Topic: Fire protection
Grade Level: 7-12
Agency: State Department of Forestry

Title: **Fireproof Your Forest Home**
Description: A small brochure with photographs showing how to clear the area around a structure to help prevent it from burning in case of a forest fire.
Topic: Fire prevention
Grade Level: 4-6
Agency: State Department of Forestry

Title: **Fire. Will Your Home be Next?**
Description: Pamphlet describing steps to take to reduce fire hazards to a structure by 70 percent.
Topic: Fire prevention
Grade Level: 7-12
Agency: State Depatment of Forestry

Title: **Handbook on California Natural Resources**
Description: An informational guide to the development and maintenance of programs in natural resource use and conservation. Good basic information on soil, water, minerals, air, plant, and animal life.
Topic: Natural resources
Grade Level: 8-12
Agency: State Department of Conservation

Title: **Hints for Water Conservation**
Description: An information bulletin outlining home water conservation strategies.
Topic: Water conservation
Grade: 4-6
Agency: State Department of Water Resources

Title: **Impact of Severe Drought in Marin County, California**
Description: A 1979 publication that outlines the effects of water shortage on residences, businesses, and livestock ranches. Contains many figures and tables of water use data. A good case study for secondary use.
Topic: Drought
Grade Level: 7-12
Agency. State Department of Water Resources

Title: **Joint Investigation by the California Energy Commission and the California Public Utilities Commission into the Availability and Potential Use of Solar Energy in California**
Description: A technical report that outlines the desirability of using solar energy for domestic water heating and passive space heating. Useful as a benchmark in studying the history of solar-related legislation in California. Recommendations for incentives utilities can use to motivate their customers to use solar energy are outlined. This publication can be used as a checklist of the progress made by the utilities in carrying out the recommendations listed.
Topic: Energy
Grade Level: 10-12
Agency: California Energy Commission

Title: **Save Energy**
Description: A survey of current activities in energy management of local, statewide, and national significance. Articles highlight CEES activities of local community groups, grant and utility programs, local government options, and state agencies working in energy. Each issue usually contains a policy piece and reproducible reference feature.
Topic: Energy management programs and policy
Grade Level: Designed for decision makers. Would be useful in high school as well.
Agency: California Energy Extension Service

Title: **Save Water**
Description: A graphically pleasing brochure outlining water conservation techniques. A good succinct introduction for use at all levels, including primary.
Topic: Water conservation
Grade Level: K-12
Agency: State Department of Water Resources

Title: **Solar Here and Now**
Description: A pamphlet detailing active and passive heating techniques.
Topic: Solar energy
Grade Level: 6-12
Agency: California Energy Commission

Title: **Solar Installers Training Manual**
Description: Over 200-page curriculum of domestic hot water systems, pool systems, and space heating systems. Manual is accurate, complete, and extremely practical and is currently used in over 15 training programs.
Topic: Training for solar installers
Grade Level: High school
Agency: SolarWork Institute, California Energy Extension Services (CEES)

Title: **Solar Pool Heating**
Description: A pamphlet illustrating how solar heats pool water and how the water cools off. Pool covers are discussed along with other ways heat may be conserved. Good information on collectors, collector tilt and sizing, controls, mounting the collectors; maintenance and installation are also covered.
Topic: Solar energy
Grade Level: 7-12
Agency: California Energy Commission

Title: **Synthetic Oil vs. Methanol as a Liquid Fuel Product from Waste Conversion Processes**
Description: A technical report describing the processes by which municipal, agricultural, and forestry wastes can be converted into ethanol or methanol, and a discussion of the ways ethanol and methanol can be used to substitute for gasoline, natural gas, or diesel oil in combustion turbines for generating electricity as fuel for automobiles and as a fuel for boilers.
Topic: Energy from municipal, agricultural, and forest wastes
Grade Level: 10-12
Agency: California Energy Commission

Title: **The LNG Decision in California: Reliability, Cost, Safety, and Siting**
Description: Good resource describing LNG world trade routes, facilities, and terminals with numerous charts and tables relating to LNG cost, safety, and siting.
Topic: Energy/LNG
Grade Level: 10-12
Agency: California Energy Commission

Title: **Urban Forestry**
Description: A four-page pamphlet dealing with planting trees in urban areas. Urban forestry projects are described which could be duplicated by a class.
Topic: Trees
Grade Level: K-12
Agency: State Department of Forestry

Title: **Water Conservation in California**
Description: A 1976 publication describing water uses in California. Water conservation strategies for residences, businesses, and agriculture are outlined. Many figures and tables are included.
Topic: Water
Grade Level: 7-12
Agency: State Department of Water Resources

Title: **Water Pricing**
Description: An information bulletin describing water pricing strategies that can encourage water conservation.
Topic: Water conservation
Grade Level: 10-12
Agency: State Department of Water Resources

Title: **Water Saving Planting Ideas** (reprinted from *Sunset* magazine)
Description: An informative article describing drought-tolerant or drought-resistant plants for California gardens.
Topic: Water conservation
Grade Level: 7-12
Agency: Department of Water Resource

Title: **Wind-Electric Power, A Renewable Energy Resource for California**
Description: An overview of the use of wind in California to generate electricity. Includes a map of high-wind areas in the state and a summary of the California wind program through 1978. (This can be updated with more current information from the ECE Wind Office.)
Topic: Energy/Wind-Electricity
Grade Level: 10-12
Agency: California Energy Commission

RESIDENT OUTDOOR EDUCATION

Resident outdoor education programs are based on three ingredients for effective learning: a specific body of content, firsthand experience, and personal identification with the affective goals of the program. As the name implies, outdoor education takes place outdoors in the natural environment. The setting is a laboratory where firsthand observations provide the examples that lead to discovering and confirming the scientific principles on which the program is based. Personal verification of facts, principles, and aesthetic appreciation is at the core of every learning experience. Since the environment is teacher and textbook, the group leader is free to act as a resource person and carry on a dialogue with students, exchanging observations and ideas, making generalizations based on multiple observations, and expressing the feelings and appreciation that a close study of the natural environment evokes.

Outdoor settings are generally crowded with interesting things to observe and think about. Students are easily involved with the content of the setting. This makes it possible for the leader to move easily from working with individuals, to small groups, or the total group. Independence and personal responsibility are emphasized in making observations, initiating dialogues, exchanging ideas, and assuming responsibility for learning.

The natural environment is an optimal setting for developing positive attitudes about the relationship of self to the environment. Examples of cause and effect relationships are available everywhere. There is immediate feedback on the consequences of human action on the environment. Within this context, students can develop a sense of personal responsibility in caring for the environment.

Recognition of the inherent beauty in an outdoor setting brings a richness to our lives that is beyond words. The multitude of living things—plants and animals—in the natural environment can be used to build a respect for the preciousness of life. The variety of forms living in harmony and for mutual benefit in a small area of the environment are representative of the principles that govern all of nature.

California public schools are fortunate to have access to a variety of resident outdoor school programs. Because these programs are an integral part of environmental education, a directory of city and county programs follows:

City and County Resident Outdoor Education Programs

Fresno County
Chuck Kaylor
Regional Learning Center
Route 3, Box 530
Sonora, CA 95370
(209) 532-3691

Glenn County
Ralph Herman
525 West Sycamore
Willows, CA 95988
(916) 934-7011

Humboldt County
Cheryl Christiansen
901 Myrtle Avenue
Eureka, CA 95501
(707) 445-7611

Kern County
Ben Bird
5801 Sundale Avenue
Bakersfield, CA 93309
(805) 834-3700

Lake County
Gerald DeFries
P.O. Box 457
Boonville, CA 95433

Los Angeles Unified
Durrell Maughan
3317 Bellevue Avenue
Los Angeles, CA 90026
(213) 625-6000

Los Angeles County
9300 East Imperial Hwy.
Downey, CA 90242
(213) 922-6334

Long Beach Unified
701 Locust Avenue
Long Beach, CA 90813
(213) 436-9931

Marin County
1111 Las Galinas Avenue
San Rafael, CA 94903
(415) 472-4110

Monterey County
J. P. Van Ettinger
P.O. Box 851
Salinas, CA 93901
(408) 424-0654

Orange County
P.O. Box 15029
Santa Ana, CA 95705
(714) 953-3900

Sacramento County
Glenn Davis
5600 Sly Park Road
Pollack Pines, CA 95726
(916) 366-2718

San Francisco City & County
Lynette Porteous
135 Van Ness Avenue
San Francisco, CA 94102
(415) 505-9000

San Joaquin County
22 East Weber Avenue
Stockton, CA 95202
(209) 944-2394

San Luis Obispo County
Jim Barlow
2156 Sierra Way
San Luis Obispo, CA 93401
(805) 544-3288

San Mateo County
Glendon McFate
333 Main Street
Redwood City, CA 94063
(415) 364-5600

Santa Barbara County
Paul Jillson
4400 Cathedral Oaks Road
Santa Barbara, CA 93111
(805) 964-4711

Santa Clara County
Carl Miescke
100 Skyport Drive
San Jose, CA 95110
(408) 299-2374

Santa Cruz County
Dr. Jeanne Hubert
701 Ocean Street
Santa Cruz, CA 95060
(408) 425-2001

Shasta County
Brian Swagerty
1644 Magnolia
Redding, CA 96002
(916) 244-4600

Siskiyou County
Larry Wehmeyer
609 Gold Street
Yreka, CA 96097
(916) 842-5751

Sutter County
Jack Murtha
463 Second Street
Yuba City, CA 95991
(916) 673-6110

Tulare County
James Vidak
County Civic Center
Visalia, CA 93277
(209) 733-6386